



**YAMAHA SINGLE-AXIS ROBOT FLIP-X series**

# **F8/F8L/F8LH**

**User's Manual**

ENGLISH A small circular icon containing the letter 'E', indicating the language of the manual.

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**IM Operations**

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## **Before using the F8/F8L/F8LH single-axis robots (Be sure to read the following notes.)**

Thank you for purchasing this YAMAHA single-axis robot F8/F8L/F8LH.

Before using this robot, read the following notes and set the origin position.

The F8/F8L/F8LH single-axis robots use absolute position detectors that do not require return-to-origin after turning on the controller power. However, when the controller power is turned on in the following cases, return-to-origin must be performed just the very first time.

- (1) When robot cable was first connected after delivery from YAMAHA.
- (2) When robot cable was disconnected from the controller and then reconnected.
- (3) When no absolute battery is connected.
- (4) When a motor or cable was replaced.

At this point, any of the following errors is issued immediately after controller power is turned on, **but this is not a malfunction**. The controller will operate normally by restarting.

### **When using an SR1 controller:**

15 : FEEDBACK ERROR 2  
23 : ABS.BAT.L-VOLTAGE  
24 : ABS.DATA.ERROR  
... etc.

### **When using an RCX240, RCX222 controller:**

17.81 : D?.ABS.battery wire breakage  
17.92 : D?.Resolver disconnected during power off  
17.93 : D?.Position backup counter overflow  
... etc.

### **When using an TS-X controller:**

82 ENCODER ERROR  
83 ABS. ENCODER ERR.  
8A ABS. BATTERY ERR.  
8B ABS. COUNT ERROR  
8D ABS. OVERFLOW ERR.  
... etc.

## **Setting the origin position**

Set the origin position by referring to the following section in the robot controller user's manual.

### **When using an SR1 controller:**

See "9.1.1 Return-to-origin by the search method" in Chapter 9 of the "HPB Operation Guide" section.

### **When using an RCX240 controller:**

See "11.9 Absolute reset" in Chapter 4.

### **When using an RCX222 controller:**

See "11.8 Absolute reset" in Chapter 4.

### **When using an TS-X controller:**

See "6.2 Origin search (return-to-origin)" in "6. Operating the robot" of the "HT1 Operation Guide" section.



#### **CAUTION**

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**Changing the origin position to the opposite side of the initial position may cause a position shift or robot breakdowns, so use caution.**

**Avoid changing the origin detection method since it is dangerous in some cases. If the origin position must be changed, please consult our sales office or dealer.**

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## Introduction

The YAMAHA single-axis robots F8/F8L/F8LH is an industrial robot that uses the absolute positioning method as standard and has improved ease of use, resistance to environmental conditions, and maintenance work. A wide variety of product lineup allows you to select the desired robot model that best matches your application.

This user's manual describes the safety measures, handling, adjustment and maintenance of the F8/F8L/F8LH robots for correct, safe and effective use.

Be sure to read this manual carefully before installing the F8/F8L/F8LH robots. Even after you have read this manual, keep it in a safe and convenient place for future reference.

- This user's manual should be used with the robot and considered an integral part of it. When the robot is moved, transferred or sold, send this manual to the new user along with the robot. Be sure to explain to the new user the need to read through this manual.
- Specifications of robot models other than standard models may be omitted in this manual if they are common to those of standard models. In this case, refer to the specifications of standard models.
- For details on specific operation of the robot, refer to the separate user's manual for the robot controller being used.

### NOTES

- ◆ The contents of this manual are subject to change without prior notice.
- ◆ While every effort has been made to ensure the contents of this manual are correct, please contact us if you find any part of this manual to be unclear, confusing or inaccurate.

**MEMO**

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## 1-1 Safety information

Industrial robots are highly programmable, mechanical devices that provide a large degree of freedom when performing various manipulative tasks. To ensure correct and safe use of YAMAHA industrial robots, carefully read this manual and make yourself well acquainted with the contents. FOLLOW THE WARNINGS, CAUTIONS AND INSTRUCTIONS included in this manual. Failure to take necessary safety measures or mishandling due to not following the instructions in this manual may result in trouble or damage to the robot and injury to personnel (robot operator or service personnel) including fatal accidents.

Warning symbols and signal words used in this manual are classified as explained below. Make sure that you fully understand the meaning of each symbol and comply with the instructions.



### DANGER

**FAILURE TO FOLLOW DANGER INSTRUCTIONS WILL RESULT IN SEVERE INJURY OR DEATH TO THE ROBOT OPERATOR, BYSTANDERS OR PERSONS INSPECTING OR REPAIRING THE ROBOT.**



### WARNING

**FAILURE TO FOLLOW WARNING INSTRUCTIONS COULD RESULT IN SEVERE INJURY OR DEATH TO THE ROBOT OPERATOR, BYSTANDERS OR PERSONS INSPECTING OR REPAIRING THE ROBOT.**



### CAUTION

**Failure to follow CAUTION instructions may result in injury to the robot operator, bystanders or persons inspecting or repairing the robot, or damage to the robot and/or robot controller.**



### NOTE

Explains the key point in the operation in a simple and clear manner.

### Reference

Gives useful information related to the robot operation.

## 1-1 Safety information

1

Using the Robot Safely

Refer to the user's manual by any of the following methods to operate or adjust the robot safely and correctly.

1. Operate or adjust the robot while referring to the printed version of the user's manual (available for an additional fee).
2. Operate or adjust the robot while viewing the CD-ROM version of the user's manual on your computer screen.
3. Operate or adjust the robot while referring to a printout of the necessary pages from the CD-ROM version of the user's manual.

*It is not possible to list all safety items in detail within the limited space of this manual. So it is essential that the user have a full knowledge of basic safety rules and also that the operator makes correct judgments on safety procedures during operation.*

*For specific safety information and standards, refer to the applicable local regulations and comply with the instructions. This manual and warning labels supplied with or attached to the robot are written in English. Unless the robot operators or service personnel understand English, do not permit them to handle the robot.*

- \* Cautions regarding the official language of EU countries

For equipment that will be installed in EU countries, the language used for the user's manuals, CE declarations, and operation screen characters is English only. Warning labels only have pictograms or else include warning messages in English. In the latter case, Japanese messages might be added.

## 1-2 Essential precautions

Particularly important cautions for handling or operating the robot are described below. In addition, precautions during installation, operation, inspection and maintenance are also provided in each chapter. Be sure to comply with these instructions to ensure safe use of the robot.

### (1) Observe the following cautions during automatic operation.

- Install a safeguard (safety enclosure) to keep any person from entering within the movement range of the robot and suffering injury due to being struck by moving parts.
- Install a safety interlock that triggers emergency stop when the door or panel is opened.
- Install a safety enclosure so that no one can enter inside except from doors or panels equipped with safety interlocks.
- Warning labels 1 are supplied with the robot and should be affixed to conspicuous spots on doors or panels equipped with safety interlocks.



#### DANGER

SERIOUS INJURY OR DEATH WILL RESULT FROM IMPACT WITH MOVING ROBOT.

- KEEP OUTSIDE OF GUARD DURING OPERATION.
- LOCK OUT POWER BEFORE APPROACHING ROBOT.

#### Warning label 1



### (2) Use caution to prevent hands or fingers from being pinched or crushed.

Warning label 2 is affixed to the robot.

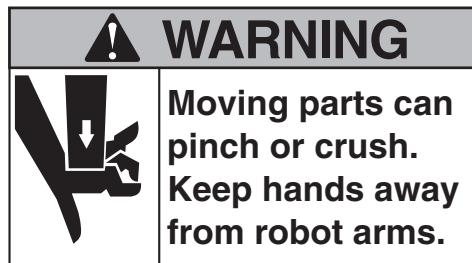
Use caution to prevent hands or fingers from being pinched or crushed by the moving parts when carrying the robot or during teaching.



#### WARNING

MOVING PARTS CAN PINCH OR CRUSH.  
KEEP HANDS AWAY FROM ROBOT ARMS.

## Warning label 2



## (3) Follow the instructions on warning labels and in this manual.

- Be sure to read the warning labels and this manual carefully and make sure you thoroughly understand their contents before attempting installation and operation of the robot.
- Before starting robot operation, be sure to reread the procedures and cautions relating to your work as well as descriptions in this chapter (Chapter 1, "Using the Robot Safely").
- Never install, adjust, inspect or service the robot in any manner that does not comply with the instructions in this manual.
- The warning labels 3 are supplied with the robot and should be affixed to the robot or conspicuous spots near the robot.

**WARNING**

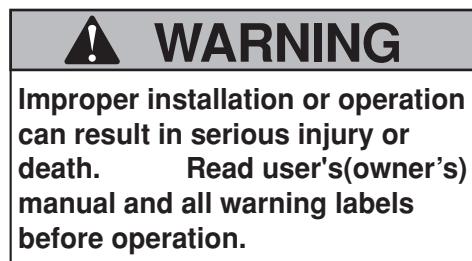
---

IMPROPER INSTALLATION OR OPERATION CAN RESULT IN SERIOUS INJURY OR DEATH.

READ THE USER'S MANUAL AND ALL WARNING LABELS BEFORE OPERATION.

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## Warning label 3



## (4) Do not remove, alter or stain the warning labels.

**WARNING**

IF WARNING LABELS ARE REMOVED OR DIFFICULT TO SEE, THEN ESSENTIAL PRECAUTIONS MIGHT NOT BE TAKEN, RESULTING IN ACCIDENTS.

- DO NOT REMOVE, ALTER OR STAIN THE WARNING LABELS ON THE ROBOT.
- DO NOT ALLOW THE WARNING LABELS TO BE HIDDEN BY DEVICES INSTALLED ONTO THE ROBOT BY THE USER.
- PROVIDE PROPER LIGHTING SO THAT THE SYMBOLS AND INSTRUCTIONS ON THE WARNING LABELS CAN BE CLEARLY SEEN EVEN FROM OUTSIDE THE SAFETY ENCLOSURE.

## (5) Do not use the robot in environments containing inflammable gas, etc.

**WARNING**

- THIS ROBOT WAS NOT DESIGNED FOR OPERATION IN ENVIRONMENTS WHERE INFLAMMABLE OR EXPLOSIVE SUBSTANCES ARE PRESENT.
- DO NOT USE THE ROBOT IN ENVIRONMENTS CONTAINING INFLAMMABLE GAS, DUST OR LIQUIDS. EXPLOSIONS OR FIRE MIGHT OTHERWISE RESULT.

## (6) Do not use the robot in locations possibly subject to electromagnetic interference, etc.

**WARNING**

AVOID USING THE ROBOT IN LOCATIONS SUBJECT TO ELECTROMAGNETIC INTERFERENCE, ELECTROSTATIC DISCHARGE OR RADIO FREQUENCY INTERFERENCE. MALFUNCTIONS MIGHT OTHERWISE OCCUR.

## (7) Use caution when releasing the brake of a vertical use robot.

**WARNING**

THE VERTICAL AXIS WILL SLIDE DOWN WHEN THE BRAKE IS RELEASED, CAUSING A HAZARDOUS SITUATION.

- PRESS THE EMERGENCY STOP BUTTON AND PROP UP THE VERTICAL AXIS WITH A SUPPORT STAND BEFORE RELEASING THE BRAKE.
- BE CAREFUL NOT TO LET YOUR BODY GET CAUGHT BETWEEN THE VERTICAL AXIS AND INSTALLATION BASE WHEN RELEASING THE BRAKE TO PERFORM DIRECT TEACH.

## 1-2 Essential precautions

### (8) Provide safety measures for end effector (gripper, etc.).



#### WARNING

- END EFFECTORS MUST BE DESIGNED AND MANUFACTURED SO THAT THEY CREATE NO HAZARDS (FOR EXAMPLE, A WORKPIECE THAT COMES LOOSE) EVEN IF POWER (ELECTRICITY, AIR PRESSURE, ETC.) IS SHUT OFF OR POWER FLUCTUATIONS OCCUR.
- IF THERE IS A POSSIBLE DANGER THAT THE OBJECT GRIPPED BY THE END EFFECTOR MAY FLY OFF OR DROP, THEN PROVIDE APPROPRIATE SAFETY PROTECTION TAKING INTO ACCOUNT THE OBJECT SIZE, WEIGHT, TEMPERATURE AND CHEMICAL PROPERTIES.

### (9) Use caution when removing the motor. (Vertical use robots)



#### WARNING

THE VERTICAL AXIS WILL SLIDE DOWN WHEN THE MOTOR IS RELEASED, CAUSING A HAZARDOUS SITUATION.

- TURN OFF THE ROBOT CONTROLLER AND PROP UP THE VERTICAL AXIS WITH A SUPPORT STAND BEFORE REMOVING THE MOTOR.
- BE CAREFUL NOT TO LET YOUR BODY GET CAUGHT BETWEEN THE VERTICAL AXIS PARTS AND INSTALLATION BASE.

### (10) Be careful not to touch the motor and peripheral parts when hot.



#### WARNING

The motor and speed reduction gear casing are extremely hot after automatic operation, so burns may occur if these are touched.

Before handling these parts during inspection or servicing, turn off the controller, wait for a while and check that the parts have cooled.

### (11) Take the following safety precautions during inspection of controller.



#### WARNING

- WHEN YOU NEED TO TOUCH THE TERMINALS OR CONNECTORS ON THE OUTSIDE OF THE CONTROLLER DURING INSPECTION, ALWAYS FIRST TURN OFF THE CONTROLLER POWER SWITCH AND ALSO THE POWER SOURCE IN ORDER TO PREVENT POSSIBLE ELECTRICAL SHOCK.
- NEVER TOUCH ANY INTERNAL PARTS OF THE CONTROLLER.
- REFER TO THE "YAMAHA ROBOT CONTROLLER USER'S MANUAL" FOR PRECAUTIONS ON HANDLING THE CONTROLLER.

**(12) Use caution not to touch the controller cooling fan.****WARNING**

- BODILY INJURY MAY OCCUR FROM COMING INTO CONTACT WITH THE COOLING FAN WHILE IT IS ROTATING.
- WHEN REMOVING THE FAN COVER FOR INSPECTION, FIRST TURN OFF THE CONTROLLER AND MAKE SURE THE FAN HAS STOPPED.

**(13) Consult us for corrective action when the robot is damaged or malfunctions occur.****WARNING**

IF ANY PART OF THE ROBOT IS DAMAGED OR ANY MALFUNCTION OCCURS, CONTINUING THE OPERATION MAY BE VERY DANGEROUS. PLEASE CONSULT YOUR YAMAHA SALES OFFICE OR DEALER FOR CORRECTIVE ACTION.

Damage or Trouble	Possible Danger
Damage to machine harness or robot cable	Electrical shock, malfunction of robot
Damage to exterior of robot	Flying outwards of damaged parts during robot operation
Abnormal operation of robot (positioning error, excessive vibration, etc.)	Malfunction of robot
Z-axis brake trouble	Dropping of load

**(14) Protective bonding****WARNING**

BE SURE TO GROUND THE ROBOT AND CONTROLLER TO PREVENT ELECTRICAL SHOCK.

**(15) Be sure to make correct parameter settings.****CAUTION**

The robot must be operated with correct tolerable moment of inertia and acceleration coefficients according to the manipulator tip mass and moment of inertia. If these are not correct, drive unit service life may end prematurely, and damage to robot parts or residual vibration during positioning may result.

**(16) Follow the specified procedures when installing, adjusting or inspecting the robot.****WARNING**

ALWAYS FOLLOW THE SPECIFIED PROCEDURES WHEN INSTALLING, ADJUSTING OR INSPECTING THE ROBOT. NEVER ATTEMPT ANY PROCEDURE NOT DESCRIBED IN THIS MANUAL.

## 1-2 Essential precautions

**(17) Do not attempt any repair, parts replacement and modification.**



**WARNING**

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DO NOT ATTEMPT ANY REPAIR, PARTS REPLACEMENT AND MODIFICATION

UNLESS DESCRIBED IN THIS MANUAL.

THESE WORKS REQUIRE TECHNICAL KNOWLEDGE AND SKILL, AND MAY ALSO INVOLVE WORK HAZARDS.

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**(18) Location for installing the controller and the programming box or Handy Terminal**

The robot controller, programming box, and Handy Terminal should be installed at a location that is outside the robot movement range yet where it is easy to operate and view the robot performing tasks.

**(19) Protect electrical wiring and hydraulic/pneumatic hoses as needed.**

Install a cover or similar item to protect the electrical wiring and hydraulic/pneumatic hoses from possible damage.

**(20) Install an operation status light.**

Install an operation status light (signal light tower, etc.) at an easy-to-see position so the operator will know whether the robot is merely stopped or is in emergency-error stop.

**(21) Clean work tools, etc.**

Work tools such as welding guns and paint nozzles which are mounted in the robot arm will preferably be cleaned automatically.

**(22) Provide adequate lighting.**

Make sure to provide enough lighting to ensure safety during work.

**(23) Prevent the gripped object from flying outwards.**

If the object or workpiece gripped by the robot might fly outward or drop and create a hazard to the operator, then protective equipment should be installed by taking the size, weight, temperature and chemical properties of the object into account.

**(24) Draw up "work instructions" and makes sure the operator learns them well.**

Decide on "work instructions" for the following items in cases where personnel must work within the robot movement range to perform teaching, maintenance or inspection. Make sure the workers know these "work instructions" well.

- (1) Robot operating procedures needed for tasks such as startup procedures and handling switches
- (2) Robot speeds used during tasks such as teaching
- (3) Methods for workers to signal each other when two or more workers perform tasks
- (4) Steps that the worker should take when a problem or emergency occurs

- (5) Steps to take after the robot has come to a stop when the emergency stop device was triggered, including checks for cancelling the problem or error state and safety checks in order to restart the robot.
- (6) In cases other than above, the following actions should be taken as needed to prevent hazardous situations due to sudden or unexpected robot operation or faulty robot operation, as listed below.
  - 1. Show a display on the operator panel
  - 2. Ensure the safety of workers performing tasks within the robot movement range
  - 3. Clearly specify position and posture during work
 

Position and posture where worker can constantly check robot movements and immediately move to avoid trouble if an error/problem occurs
  - 4. Install noise prevention measures
  - 5. Use methods for signaling operators of related equipment
  - 6. Use methods to decide that an error has occurred and identify the type of error

Implement the "work instructions" according to the type of robot, installation location, and type of work task.

When drawing up the "work instructions", make an effort to include opinions from the workers involved, equipment manufacturer's technicians, and workplace safety consultants, etc.

#### **(25) Display a sign on operation panel during work**

Display an easy to understand sign or message on the programming box, Handy Terminal, and operation panel during the job task, to prevent anyone other than the operators for that job task from mistakenly operating a start or selector switch. If needed, take other measures such as locking the cover on the operation panel.

#### **(26) Make daily and periodic inspections.**

- (1) Always make sure that daily and periodic inspections are performed, and make a pre-work check to ensure there are no problems with the robot or related equipment. If a problem or abnormality is found, then promptly repair it or take other measures as necessary.
- (2) When you make periodic inspections or repairs, make a record and store it for at least 3 years.

## 1-3 Industrial robot operating and maintenance personnel

Operators or persons who handle the robot such as for teaching, programming, movement check, inspection, adjustment, and repair must receive appropriate training and also have the skills needed to perform the job correctly and safely. They must read the user's manual carefully to understand its contents before attempting the robot operation.

Tasks related to industrial robots (teaching, programming, movement check, inspection, adjustment, repair, etc.) must be performed by qualified persons who meet requirements established by local regulations and safety standards for industrial robots.

## 1-4 Robot safety functions

### (1) Overload detection

This function detects an overload applied to the motor and shuts off the servo power.

### (2) Overheat detection

This detects an abnormal temperature rise in the controller driver and shuts off the servo power.

If an overload or overheat error occurs, take the following measures.

1. Insert a timer in the program.
2. Reduce the acceleration coefficient.

### (3) Soft limits

Soft limits can be set on each axis to limit the working envelope in manual operation after return-to-origin and during automatic operation.

Note: The working envelope is the area limited by soft limits.



#### WARNING

**SOFT LIMITS MUST BE SET WITHIN THE MOVEMENT RANGE (MECHANICAL STOPPER). IF THE SOFT LIMIT IS SET OUTSIDE THE MOVEMENT RANGE, THE ROBOT AXIS MAY COLLIDE WITH THE MECHANICAL STOPPER AT HIGH SPEED, CAUSING THE OBJECT GRIPPED BY THE END EFFECTOR TO FLY OR DROP AND THE ROBOT TO MALFUNCTION.**

### (4) Mechanical stoppers

If the servo power is suddenly shut off during high-speed operation by emergency stop or safety functions, these mechanical stoppers prevent the axis from exceeding the movement range.

Note: The movement range is the area limited by mechanical stoppers.

**WARNING**

**ROBOT MOVEMENT WILL NOT STOP IMMEDIATELY AFTER THE SERVO POWER SUPPLY IS SHUT OFF BY EMERGENCY STOP OR OTHER SAFETY FUNCTIONS.**

**(5) Vertical axis brake**

An electromagnetic brake is installed on the vertical use robot to prevent the vertical axis from sliding down when servo power is turned off. This brake is working when the controller is off or the vertical axis servo power is off even when the controller is on.

The vertical axis brake can be released with the programming box or Handy Terminal or in the program when the controller power is turned on.

**WARNING**

**THE VERTICAL AXIS WILL SLIDE DOWN WHEN THE BRAKE IS RELEASED, CREATING A HAZARDOUS SITUATION.**

- **PRESS THE EMERGENCY STOP BUTTON AND PROP THE VERTICAL AXIS WITH A SUPPORT STAND BEFORE RELEASING THE BRAKE.**
- **USE CAUTION NOT TO LET YOUR BODY GET CAUGHT BETWEEN THE VERTICAL AXIS AND INSTALLATION BASE WHEN RELEASING THE BRAKE TO PERFORM DIRECT TEACH.**

## 1-5 Safety measures for the system

Since the robot is commonly used in conjunction with an automated system, dangerous situations are more likely to occur from the automated system than from the robot itself. Accordingly, appropriate safety measures must be taken on the part of the system manufacturer according to the individual system. The system manufacturer should provide a proper instruction manual for safe, correct operation and servicing of the system.

## 1-6 Trial operation

After making installations, adjustments, inspections, or maintenance or repairs to the robot, make a trial run using the following procedures.

**(1) If a safety enclosure has not yet been provided right after installation of the robot, rope off or chain off around the movement area of the manipulator in place of the safety enclosure, and observe the following points.**

1. Use sturdy, stable posts which will not fall over easily.
2. The rope or chain should be easily visible by everyone around the robot.
3. Place a sign to keep the operator or other personnel from entering the movement range of the manipulator.

## 1-7 Work within the safety enclosure

### (2) Check the following points before turning on the controller.

1. Is the robot securely and correctly installed?
2. Are the electrical connections to the robot correct?
3. Are items such as air pressure correctly supplied?
4. Is the robot correctly connected to peripheral equipment?
5. Have safety measures (safety enclosure, etc.) been taken?
6. Does the installation environment meet the specified standards.

### (3) After the controller is turned on, check the following points from outside the safety enclosure.

1. Does the robot start and stop as intended? Can the operation mode be selected correctly?
2. Does each axis move as intended within the soft limits?
3. Does the end effector move as intended?
4. Are the signal transmissions to the end effector and peripheral equipment correct?
5. Does emergency stop work?
6. Are the teaching and playback functions normal?
7. Are the safety enclosure and interlock working as intended?
8. Does the robot move correctly during automatic operation?

## 1-7 Work within the safety enclosure

### (1) Work within the safety enclosure

When work is required inside the safety enclosure, always turn off the controller and place a sign indicating that the robot is being adjusted or serviced in order to keep any other person from touching the controller switch or operation panel, except for the following cases.

- 1) Soft limit settings
- 2) Teaching

For item 1), follow the precautions and procedure for each section. To perform item 2), refer to the description in (2) below.

### (2) Teaching

When performing teaching within the safety enclosure, comply with the instructions listed below.

- 1) Check or perform the following points from outside the safety enclosure.
  1. Make sure that no hazards are present within the safety enclosure by a visual check.
  2. Check that the programming box or Handy Terminal operates correctly.

3. Check that no failures are found in the robot.
  4. Check that emergency stop works correctly.
  5. Select teaching mode and prohibit automatic operation.
- 2) Never enter the movement range of the manipulator while within the safety enclosure.

## 1-8 Automatic operation

Automatic operation described here includes all operations in AUTO mode.

**(1) Check the following before starting automatic operation.**

1. No one is within the safety enclosure.
2. The programming box, Handy Terminal and tools are placed in their specified positions.
3. The alarm or error lamps on the robot and peripheral equipment do not flash.
4. The safety enclosure is securely installed with safety interlocks actuated.

**(2) Observe the following during automatic operation or in cases where an error occurs.**

- 1) After automatic operation has started, check the operation status and signal light to ensure that the robot is in automatic operation.
- 2) Never enter the safety enclosure during automatic operation.
- 3) If an error occurs in the robot or peripheral equipment, observe the following procedure before entering the safety enclosure.
  1. Press the emergency stop button to set the robot to emergency stop.
  2. Place a sign on the start switch, indicating that the robot is being inspected in order to keep any other person from touching the start switch and restarting the robot.

## 1-9 Warranty

The YAMAHA robot and/or related product you have purchased are warranted against the defects or malfunctions as described below.

**Warranty description** : If a failure or breakdown occurs due to defects in materials or workmanship in the genuine parts constituting this YAMAHA robot and/or related product within the warranty period, then YAMAHA will repair or replace those parts free of charge (hereafter called "warranty repair").

**Warranty Period** : The warranty period ends when any of the following applies:

- (1) After 18 months (one and a half year) have elapsed from the date of shipment
- (2) After one year has elapsed from the date of installation
- (3) After 2,400 hours of operation

**Exceptions to the Warranty** : This warranty will not apply in the following cases:

- (1) Fatigue arising due to the passage of time, natural wear and tear occurring during operation (natural fading of painted or plated surfaces, deterioration of parts subject to wear, etc.)
- (2) Minor natural phenomena that do not affect the capabilities of the robot and/or related product (noise from computers, motors, etc.).
- (3) Programs, point data and other internal data that were changed or created by the user.

Failures resulting from the following causes are not covered by warranty repair.

- 1) Damage due to earthquakes, storms, floods, thunderbolt, fire or any other natural or man-made disasters.
- 2) Troubles caused by procedures prohibited in this manual.
- 3) Modifications to the robot and/or related product not approved by YAMAHA or YAMAHA sales representatives.
- 4) Use of any other than genuine parts and specified grease and lubricants.
- 5) Incorrect or inadequate maintenance and inspection.
- 6) Repairs by other than authorized dealers.

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**MEMO**

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2-2 Robot part names	2-1



## 2-1 Checking the product

After unpacking, make sure that all components and accessories are included (as specified in your order). Also check the product for any damage on the exterior which might have occurred during shipping.

If there are any missing parts or damage due to shipping, please notify your YAMAHA sales office or representative immediately.

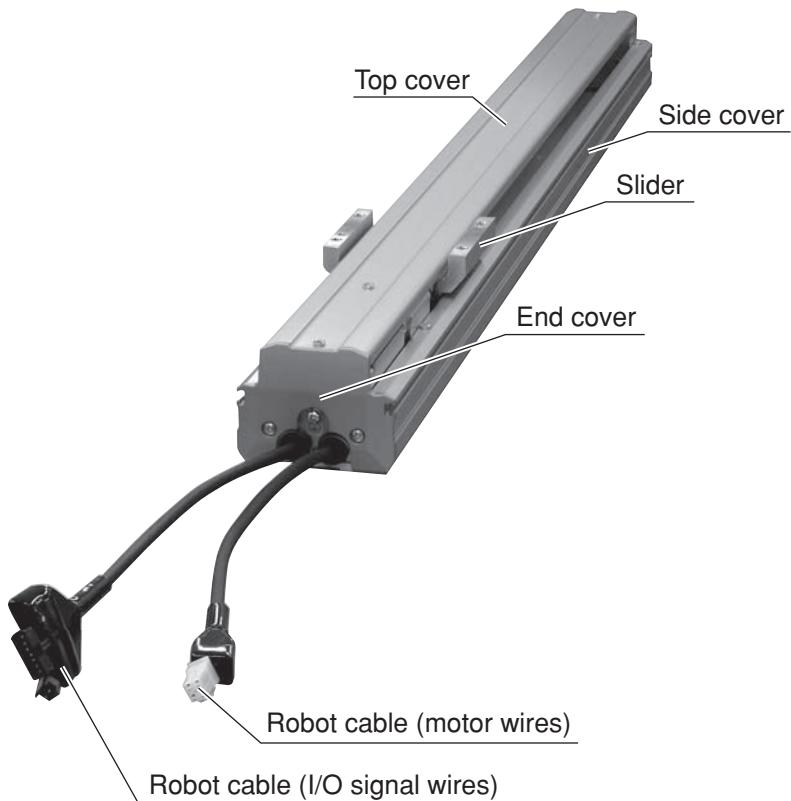


### WARNING

- ALWAYS USE TWO OR MORE PEOPLE TO TAKE THE ROBOT UNIT OUT OF THE PACKAGE. EACH PERSON SHOULD GRIP THE ROBOT UNIT NEAR ONE END FROM THE LOWER SIDE. CARRY WITH THE ROBOT FACING UPWARD (SLIDER SIDE UPWARDS).
- WHEN UNPACKING, CAREFULLY HOLD THE ROBOT NOT TO DROP IT. IF THE ROBOT FALLS, SERIOUS INJURY MAY OCCUR OR THE ROBOT MAY BE DAMAGED.

## 2-2 Robot part names

### Robot part names



**MEMO**

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## 3-1 Carrying the robot

Always use two people to carry the robot unit. Each person should grip the robot unit near one end from the lower side and carry with the load well balanced. Carry with the robot facing upward (slider side upwards).



### WARNING

ALWAYS OBSERVE THE FOLLOWING PRECAUTIONS WHEN CARRYING THE ROBOT.

- REMOVE ANY AND ALL OBJECTS SUCH AS HANDS AND GRIPPERS ATTACHED TO THE ROBOT SLIDER BEFORE MOVING THE ROBOT. THE SLIDER WILL LOSE BALANCE IF MOVED WITH OBJECTS STILL ATTACHED AND CAUSE INJURIES.
- KEEP THE ROBOT BALANCED AND DON'T LET IT TILT WHILE MOVING IT. IF THE ROBOT TILTS, THE SLIDER MAY MOVE UNDER ITS OWN WEIGHT CAUSING SERIOUS INJURIES SUCH AS CRUSHED FINGERS.
- MOVE THE SLIDER SO THAT BALL NUT SECTION IS POSITIONED IN THE NEAR CENTER OF THE ROBOT BEFORE CARRYING THE ROBOT. FAILURE TO DO SO MAY CAUSE THE BALL SCREW TO SWING OR VIBRATE LARGELY WHILE CARRYING THE ROBOT.
- NEVER ATTEMPT TO HOLD THE ROBOT IN ANY OF THE FOLLOWING MANNERS.  
[Never try this when moving!]
  - DO NOT CARRY BY HOLDING THE SLIDER.
  - DO NOT CARRY BY HOLDING THE CABLE.
  - DO NOT CARRY BY GRIPPING THE END COVER.
  - DO NOT CARRY BY HOLDING THE TOP COVER.

## 3-2 Robot installation conditions

### 3-2-1 Installation environments

Be sure to install the robot in the following environments.

Items	Specifications
Allowable ambient temperature	0 to 45°C
Allowable ambient humidity	35 to 85% RH (no condensation)
Altitude	0 to 1000 meters above sea level
Ambient environments	<p>Avoid installing near water, cutting water, oil, dust, metallic chips and organic solvent.</p> <p>Avoid installation near corrosive gas and corrosive materials.</p> <p>Avoid installation in atmosphere containing inflammable gas, dust and liquid.</p> <p>Avoid installation near objects causing electromagnetic interference, electrostatic discharge and radio frequency interference.</p>
Vibration	Do not subject to impacts or vibrations.
Working space	Allow sufficient space margin to perform jobs (teaching, inspection, repair, etc.)

For detailed information on how to install the robot controller, refer to the separate "YAMAHA Robot Controller User's Manual".



#### WARNING

AVOID INSTALLING THE ROBOT IN LOCATIONS WHERE THE AMBIENT CONDITIONS MAY EXCEED THE ALLOWABLE TEMPERATURE OR HUMIDITY, OR IN ENVIRONMENTS WHERE EXCESSIVE MOISTURE, CORROSIVE GASES, METALLIC POWDER OR DUST ARE GENERATED. MALFUNCTIONS, FAILURES OR SHORT CIRCUITS MAY OTHERWISE RESULT.



#### WARNING

- THIS ROBOT WAS NOT DESIGNED FOR OPERATION IN ENVIRONMENTS WHERE INFLAMMABLE OR EXPLOSIVE SUBSTANCES ARE PRESENT.
  - DO NOT USE THE ROBOT IN ENVIRONMENTS CONTAINING INFLAMMABLE GAS, DUST OR LIQUIDS.
- EXPLOSIONS OR FIRE COULD OTHERWISE RESULT.

**WARNING**

AVOID USING THE ROBOT IN LOCATIONS SUBJECT TO ELECTROMAGNETIC INTERFERENCE, ELECTROSTATIC DISCHARGE OR RADIO FREQUENCY INTERFERENCE. MALFUNCTIONS MAY OTHERWISE OCCUR.

**WARNING**

DO NOT USE THE ROBOT IN LOCATIONS SUBJECT TO EXCESSIVE VIBRATION. ROBOT INSTALLATION BOLTS MAY OTHERWISE BECOME LOOSE CAUSING THE ROBOT TO FALL OVER.

### 3-2-2 Installation base

To mount the robot, use an installation base that satisfies the following conditions.

- (1) The installation base is subjected to a great deal of stress while the robot is in operation. Prepare a sufficiently rigid and stable installation base, taking into account the robot weight including the end effector (gripper) and workpiece.

**WARNING**

IF THE INSTALLATION BASE IS NOT SUFFICIENTLY RIGID AND STABLE, VIBRATION (RESONANCE) MAY OCCUR DURING OPERATION, CAUSING ADVERSE EFFECTS ON THE ROBOT WORK.

- (2) The installation base surface must be machined within a flatness of  $\pm 0.05\text{mm}/500\text{mm}$ .

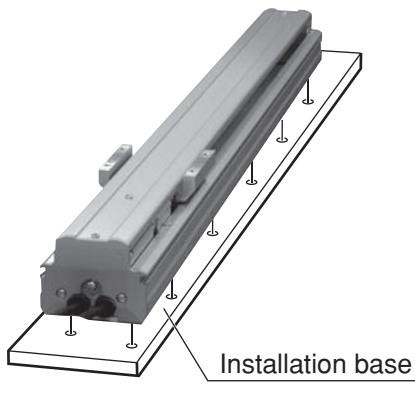
**CAUTION**

The robot positioning accuracy or the service life might be reduced if the installation surface precision is insufficient.

### 3-2 Robot installation conditions

- (3) Use an installation base of sufficient size to match the robot body so that the robot can be installed with the specified number of bolts. Avoid installing the robot with less than the specified number of bolts or installing the robot closer to one end as shown at the lower right.

#### Robot installation example



Good example



Bad example



#### WARNING

WHEN INSTALLING THE ROBOT, ALWAYS USE ALL THE MOUNTING HOLES DRILLED IN THE BOTTOM OF THE ROBOT. USING LESS THAN THE SPECIFIED NUMBER OF BOLTS TO INSTALL THE ROBOT MAY CAUSE VIBRATION AND POOR POSITIONING ACCURACY. THIS MAY ALSO RESULT IN POSITIONING ERRORS AND REDUCED SERVICE LIFE IN THE WORST CASES.



#### NOTE

Positions of robot mounting holes differ according to the stroke length of each robot. Refer to the dimensional outlines shown in "6-1 Main unit specifications".

## 3-3 Installing the robot



### WARNING

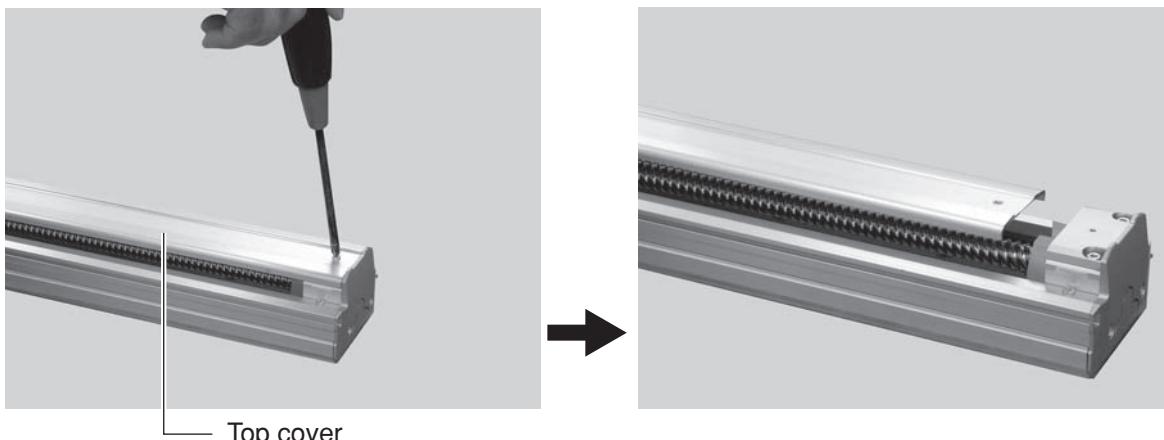
- BEFORE INSTALLING THE ROBOT, ALWAYS MAKE SURE THAT THE ROBOT CONTROLLER IS NOT CONNECTED TO THE ROBOT OR THE POWER TO THE CONTROLLER IS OFF. SERIOUS ACCIDENTS MAY OCCUR IF THE ROBOT STARTS TO OPERATE DURING INSTALLATION.
- BE SURE TO USE THE BOLTS OF THE SPECIFIED SIZE AND LENGTH AND TIGHTEN THEM SECURELY TO THE CORRECT TORQUE IN THE CORRECT POSITIONS. FAILURE TO FOLLOW THIS INSTRUCTION MAY CAUSE ROBOT VIBRATIONS, POSITION ERRORS AND SERIOUS ACCIDENTS.
- DO NOT USE A BOLT LONGER THAN THE SPECIFIED LENGTH SINCE IT MAY INTERFERE WITH THE INTERNAL PARTS OF THE ROBOT AND CAUSE MALFUNCTIONS.

1) Drill and tap M5 holes into the surface of the installation base.

Refer to the dimensional outlines shown in "6-1 Main unit specifications" in Chapter 6 for drilling positions.

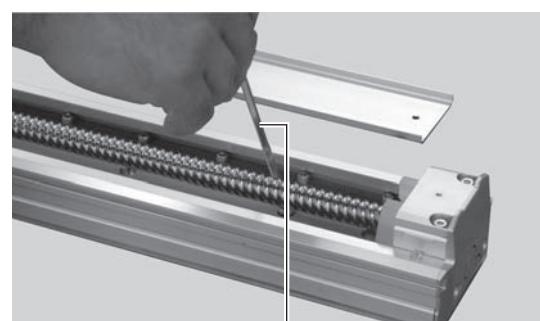
2) Remove the three screws securing the robot top cover and remove the top cover.

Move the slider to a position where the mounting holes in the bottom of the robot are not hidden under the slider.



3) Secure the robot to the installation base with the specified bolts. The specified bolts and tightening torque are shown below.

<b>Bolt</b>	Hex socket-head M5 bolt, Strength: 8.8T Length: 20mm or more
<b>Tightening torque</b>	60kgf·cm to 90kgf·cm



M5 hex wrench

4) After installing the robot, reattach the top cover.

### 3-3 Installing the robot

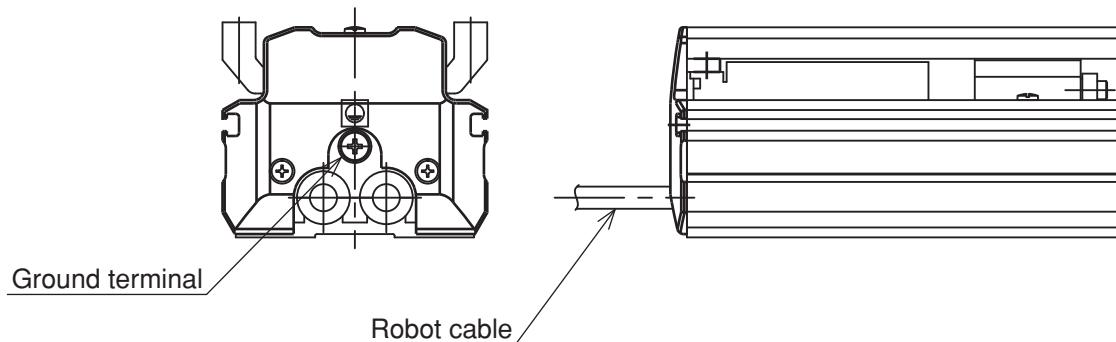
#### ● Protective bonding



##### WARNING

ALWAYS GROUND THE ROBOT AND CONTROLLER UNIT TO PREVENT ELECTRICAL SHOCK.

Always use the ground terminal (M4 screw) on the robot unit to make ground connection. The ground terminal location is shown below.



##### CAUTION

- A secure ground connection (less than 100-ohm resistance to ground) is recommended.
- Use electrical wire thicker than AWG14 (2mm<sup>2</sup>) as the ground wire.



##### WARNING

ALWAYS TURN OFF THE POWER TO THE CONTROLLER BEFORE MAKING THE GROUND CONNECTION.

Provide a terminal marked "PE" as the protective conductor for the entire system, and connect it to an external protective conductor. Also securely connect the ground terminal on the robot frame to the protective conductor.



(Symbol 417-IEC-5019)

## 3-4 Connecting the robot to the controller

### 3-4 Connecting the robot to the controller

Connect the robot cables to the mating connectors on the controller as shown. Refer to the robot controller user's manual for the controller connectors.



#### WARNING

- BEFORE CONNECTING THE CABLES, CHECK THAT THERE ARE NO BENDS OR BREAKS IN THE ROBOT CABLE CONNECTOR PINS AND THAT THE CABLES ARE NOT DAMAGED. CONTACT FAILURE MAY CAUSE ROBOT MALFUNCTIONS.
- ALWAYS MAKE SURE THAT THE POWER TO THE ROBOT CONTROLLER IS OFF BEFORE CONNECTING THE ROBOT CABLES TO THE CONTROLLER.



#### CAUTION

After connecting the robot cable intermediate connectors together, fit the connector hoods together securely.

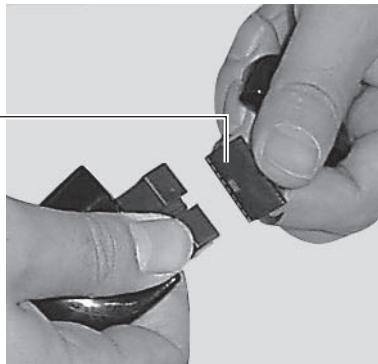


Intermediate connector (motor wire)

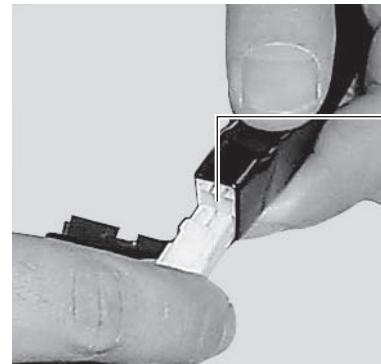
Intermediate connector (signal wire)

- 1) Connect the robot cables (motor and signal wires) to the mating connectors coming out from the robot.

Robot cable connector (signal wire)

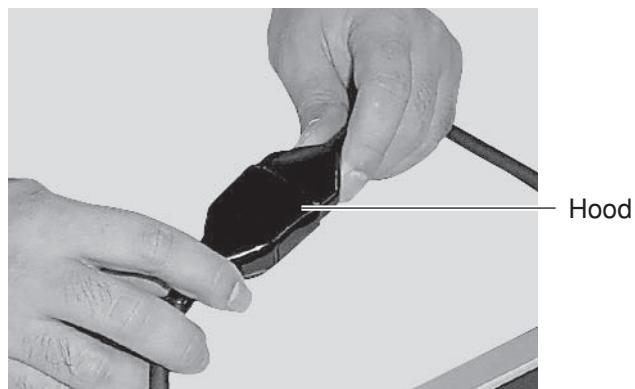


Robot cable connector (motor wire)



### 3-4 Connecting the robot to the controller

2) After making the connections, fit the connector hoods together securely.

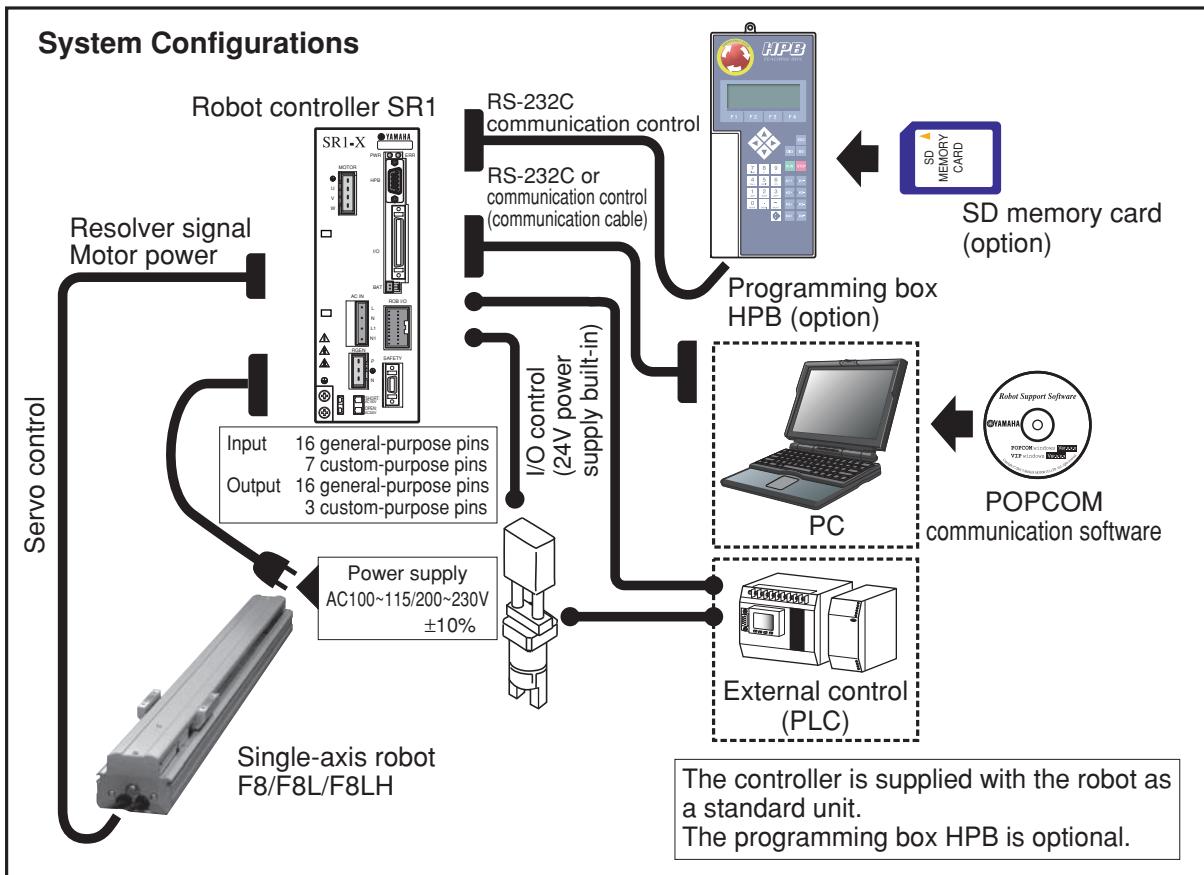
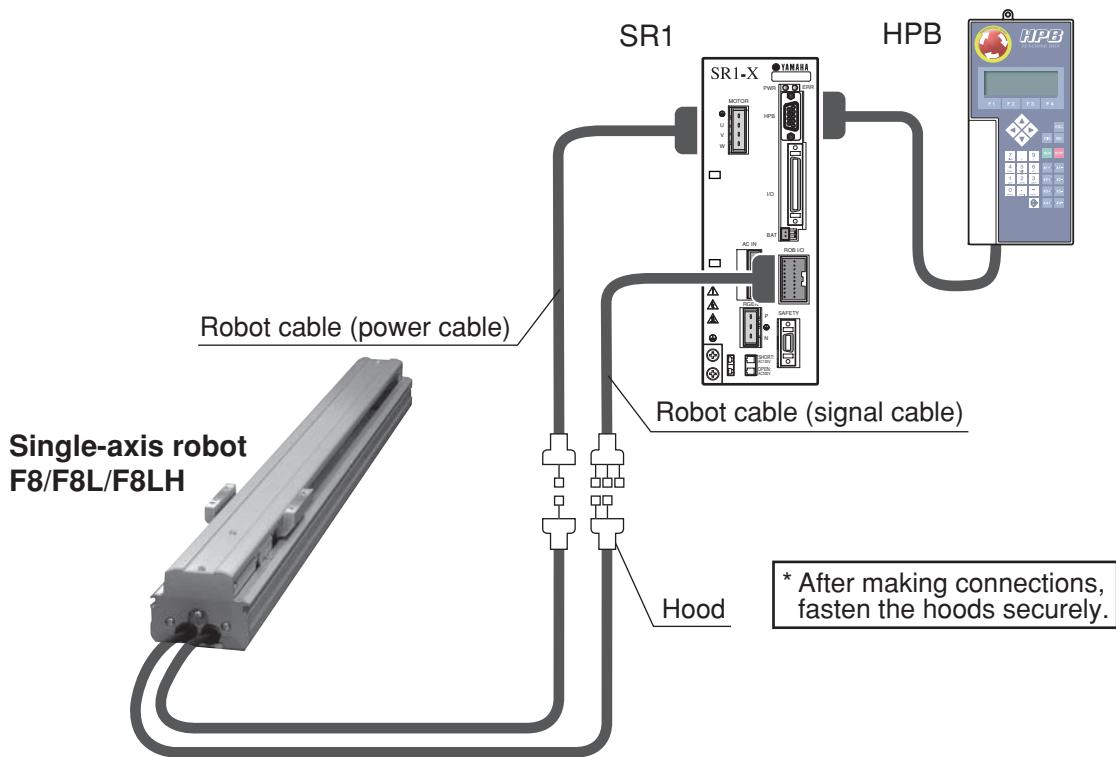


3

Installation and Connections

### 3-4 Connecting the robot to the controller

#### ● Robot cable connections (when connected to SR1)



## 3-5 Setting the operating conditions

### 3-5-1 Payload

Optimal acceleration for the YAMAHA single-axis robots is automatically determined by setting the controller payload parameters. Set the total weight of the workpiece and the end effectors such as grippers attached to the robot slider in the payload parameter as shown below.



#### CAUTION

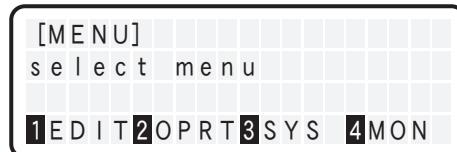
Be sure to enter an accurate value when making this setting, since a mistake will cause troubles such as vibration or a shorter machine service life span.

#### ● To set the payload parameter

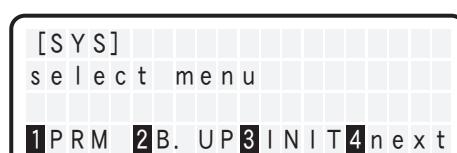
Use the following method when setting the payload parameter on a single-axis robot controller (SR1). If other controllers (RCX240, RCX222, TS-X) are used, refer to their respective user's manual.

- 1) Connect the HPB to the SR1 controller and turn on the controller power. The initial menu then appears on the HPB.

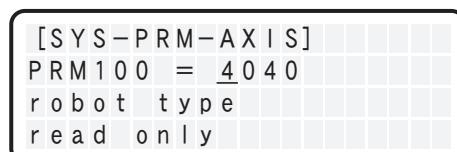
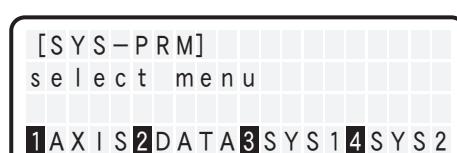
- 2) Press **F3** (SYS) on the initial menu screen.  
The SYS (system) mode screen appears.



- 3) Press **F1** (PRM) to enter the parameter setting mode.  
The SYS-PRM mode screen appears.



- 4) Select the parameter group.  
Press **F1** (AXIS) to select the axis parameter.  
The current setting for PRM100 (Robot type) appears on the screen.



The robot type No. displayed on the screen shows an example of model F10.

5) Display PRM112 (payload).

Press the  $\blacktriangle$   $\blacktriangledown$  keys to scroll up or down the parameter list and select the parameter you want to set.

[S Y S - P R M - A X I S]
PRM112 = 10 [K g]
payload
range 0→MAX

6) Set the parameter.

Enter the parameter value with the number keys and press  $\Rightarrow$ .

The parameter setting range is shown on the bottom line of the screen.

When setting is complete, the cursor moves back to the beginning of the parameter data.

[S Y S - P R M - A X I S]
PRM112 = 10 [K g]
payload
range 0→MAX

### 3-5-2 Maximum speed setting

In operation of a single-axis robot with a long stroke ball screw, resonance of the ball screw may occur. In this case, the maximum speed must be reduced to an appropriate level. The maximum speed can be reduced by lowering the SPEED setting in automatic operation or by programming. Use the desired method that matches your application. Refer to Chapter 6, "Specifications" for information on how to set the maximum speed according to the stroke length.

If the maximum speed does not reach a hazardous level, reducing the speed is unnecessary even when a robot has a long stroke axis.



#### CAUTION

---

**Do not operate the robot if the ball screw is vibrating. The ball screw may otherwise wear out prematurely.**

---

### 3-5-3 Duty

To achieve maximum service life for the YAMAHA single-axis robots, it is recommended to operate the robot within the allowable duty (50%). The duty is calculated as follows:

$$\text{Duty (\%)} = \frac{\text{Operation time}}{\text{Operation time} + \text{Non-operation time}} \times 100$$

If the robot duty is too high, an error such as "overload" or "overheat" may occur. In this case, increase the stop time to reduce the duty.

**MEMO**

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<b>4-2 Periodic inspection</b>	<b>4-3</b>
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## 4-1 Before beginning work

Periodic inspection and maintenance are essential to ensure safe and efficient operation of YAMAHA robots. This chapter describes periodic inspection items and procedures for the F8/F8L/F8LH. Before beginning work, read the precautions below and also in Chapter 1 "Using the Robot Safely" and follow the instructions.



### DANGER

IF THE INSPECTION OR MAINTENANCE PROCEDURE CALLS FOR OPERATION OF THE ROBOT, STAY OUT OF THE WORKING AREA OF THE ROBOT DURING OPERATION. DO NOT TOUCH ANY PARTS INSIDE THE CONTROLLER. KEEP WATCHING THE ROBOT MOVEMENT AND SURROUNDING AREA SO THAT THE OPERATOR CAN PRESS THE EMERGENCY STOP BUTTON IF ANY DANGER OCCURS.



### WARNING

- WHEN THE ROBOT DOES NOT NEED TO BE OPERATED DURING ADJUSTMENT OR MAINTENANCE, ALWAYS TURN OFF THE CONTROLLER AND THE EXTERNAL SWITCH BOARD.
- DO NOT TOUCH INTERNAL PARTS OF THE CONTROLLER FOR 10 MINUTES AFTER THE CONTROLLER HAS BEEN TURNED OFF.
- WHEN ONLY MAKING ELECTRICAL INSPECTIONS AND REQUIRING NO MECHANICAL MOVEMENT OF THE ROBOT, KEEP THE EMERGENCY STOP BUTTON PRESSED.
- USE ONLY LUBRICANT AND GREASES SPECIFIED BY YAMAHA SALES OFFICE OR REPRESENTATIVE.
- USE ONLY PARTS SPECIFIED BY YAMAHA SALES OFFICE OR REPRESENTATIVE. TAKE SUFFICIENT CARE NOT TO ALLOW ANY FOREIGN MATTER TO CONTAMINATE THEM DURING ADJUSTMENT, PARTS REPLACEMENT OR REASSEMBLY.
- DO NOT MODIFY ANY PARTS ON THE ROBOT OR CONTROLLER. MODIFICATION MAY RESULT IN UNSATISFACTORY SPECIFICATIONS OR THREATEN OPERATOR SAFETY.
- WHEN ADJUSTMENT OR MAINTENANCE IS COMPLETE, RETIGHTEN THE BOLTS AND SCREWS SECURELY.
- DURING ROBOT ADJUSTMENT OR MAINTENANCE, PLACE A SIGN INDICATING THAT THE ROBOT IS BEING ADJUSTED OR SERVICED TO PREVENT OTHERS FROM TOUCHING THE CONTROL KEYS OR SWITCHES. PROVIDE A LOCK ON THE SWITCH KEYS OR ASK SOMEONE TO KEEP WATCH AS NEEDED.

When applying grease to the ball screw and linear guide, take the following precautions.



### WARNING

#### PRECAUTIONS WHEN HANDLING GREASE:

- INFLAMMATION MAY OCCUR IF THIS GETS IN THE EYES.  
BEFORE HANDLING THE GREASE, WEAR YOUR SAFETY GOGGLES TO ENSURE THE GREASE WILL NOT COME IN CONTACT WITH THE EYES.
- INFLAMMATION MAY OCCUR IF THE GREASE COMES INTO CONTACT WITH SKIN. BE SURE TO WEAR PROTECTIVE GLOVES TO PREVENT CONTACT WITH SKIN.
- DO NOT TAKE ORALLY OR EAT. (EATING WILL CAUSE DIARRHEA AND VOMITING.)
- HANDS AND FINGERS MIGHT BE CUT WHEN OPENING THE GREASE CONTAINER, SO USE PROTECTIVE GLOVES.
- KEEP OUT OF THE REACH OF CHILDREN.
- DO NOT HEAT THE GREASE OR PLACE NEAR AN OPEN FLAME SINCE THIS COULD LEAD TO SPARKS AND FIRES.

#### EMERGENCY TREATMENT:

- IF GREASE GETS IN THE EYES, WASH LIBERALLY WITH PURE WATER FOR ABOUT 15 MINUTES AND CONSULT A PHYSICIAN FOR TREATMENT.
- IF GREASE COMES IN CONTACT WITH THE SKIN, WASH AWAY COMPLETELY WITH SOAP AND WATER.
- IF TAKEN INTERNALLY, DO NOT INDUCE VOMITING BUT PROMPTLY CONSULT A PHYSICIAN FOR PROPER TREATMENT.

## 4-2 Periodic inspection

### 4-2-1 Daily inspection

Check the following points on a daily basis, before and after robot operation.

Checkpoints	Check items	Notes
Cables	Check for damage, dent and excessively tight bends.	Replace if needed.
Ball screw, bearing	Check for unusual vibration and noise.	
Motor	Check for unusual vibration and noise, and for abnormal temperature rise.	

### 4-2-2 Three-month inspection

Take the following precautions when performing 3-month inspection.



#### WARNING

THE SLIDER OF VERTICAL USE ROBOT WILL SLIDE DOWN WHEN THE BRAKE IS RELEASED, CAUSING A HAZARDOUS SITUATION. DO NOT RELEASE THE BRAKE WHEN LUBRICATING VERTICAL USE ROBOT PARTS.

Check the following points every 3 months and apply grease if needed.

Checkpoints	Check items	Notes
Ball screw, linear guide, ball bushing	<ul style="list-style-type: none"> <li>Check for dust buildup or debris. Clean if necessary. Apply grease after cleaning.</li> <li>Check to see if the ball screw, linear guide and ball bushing are lubricated (not dry). Apply grease if necessary.</li> </ul> <p>Standard robots: Albania No. 2 (Shell) Daphne Eponex No. 2 (Idemitsu) Clean room robots: LG-2 (NSK)</p>	See "4-3" in this chapter.



#### CAUTION

Using grease other than those recommended by YAMAHA might shorten the service life of the ball screw, linear guide and linear bushing shaft.

### 4-2-3 Six-month inspection

Take the following precautions when performing 6-month inspection.



#### WARNING

**THE SLIDER OF VERTICAL USE ROBOT WILL SLIDE DOWN WHEN THE BRAKE IS RELEASED, CAUSING A HAZARDOUS SITUATION. DO NOT RELEASE THE BRAKE WHEN LUBRICATING THE VERTICAL USE ROBOT PARTS.**

Check the following points every 6 months and adjust or replace parts if needed.

Checkpoints	Check items	Notes
Major bolts and screws on robot	Check for looseness. Tighten if loose.	
Ball screw, linear guide	<ul style="list-style-type: none"> <li>Check the ball screw and linear guide for backlash. Tighten if necessary.</li> <li>Check for vibration during operation. Tighten bolts if necessary to secure drive unit and/or shaft.</li> <li>Check for backlash due to wear.</li> </ul>	Consult us if problem cannot be solved or there is backlash due to wear.
Controller	<ul style="list-style-type: none"> <li>Check if terminals are loose.</li> <li>Check if connectors are loose</li> </ul>	
Greasing to ball screw/nut section and linear guide	Apply grease every 6 months to ball screw/nut and linear guide. Recommended grease Albania No. 2 (Shell) Daphne Eponex No. 2 (Idemitsu)	See "4-3" in this chapter.
Slider	On long-stroke (750mm or more) robots, check the slider inside the top cover for wear or damage every 6 months.	



#### CAUTION

**Using grease other than those recommended by YAMAHA might shorten the service life of the ball screw and linear guide.**

### 4-2-4 Three-year inspection

Check the following points every 3 years or more often if the robot is used frequently.

Checkpoints	Check items	Notes
Ball screw/nut section and linear guide	Check ball screw/nut and linear guide for backlash due to wear.	Consult us if abnormal condition is found.

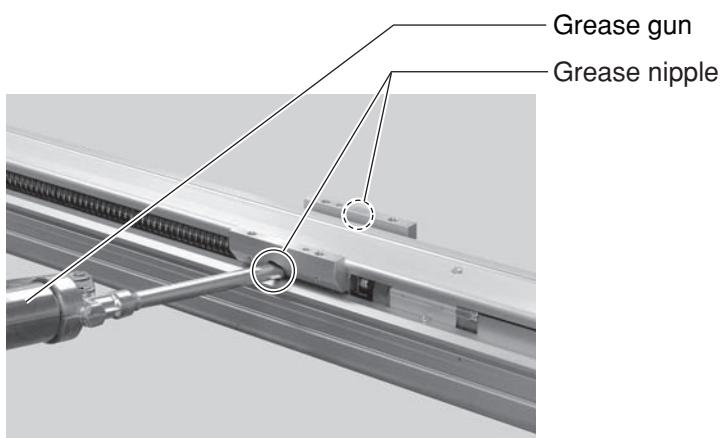
## 4-3 Applying grease

When applying grease to the ball screw according to periodic inspection, follow the procedure below. Grease can be applied to the guide sliding section using the grease nipples. Prepare a grease gun in this case.

- 1) Make sure that the power to the controller is off.
- 2) Apply grease by either of the following methods.

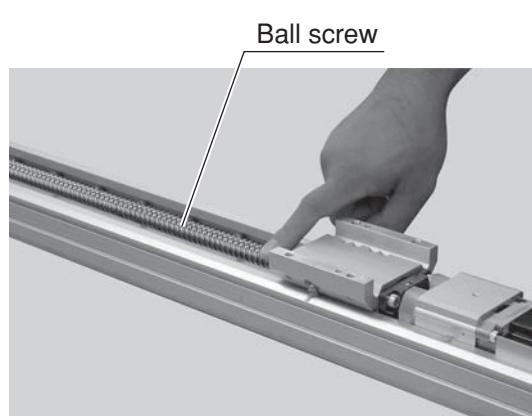
### ● Linear guide

When using the grease nipples, apply grease into the two grease nipples on the left and right side of the slider (4 grease nipples for F8LH). Then move the table slider back and forth to help spread the grease around.



### ● Ball screw

- 1) Remove the screws securing the robot top cover and remove the top cover.  
(For how to remove the top cover, refer to "3-3 Installing the robot".)
- 2) Apply grease by hand to the ball screw and move the table slider back and forth to help spread the grease around.



- 3) Reattach the top cover and end covers.

## 4-4 Replacing the motor

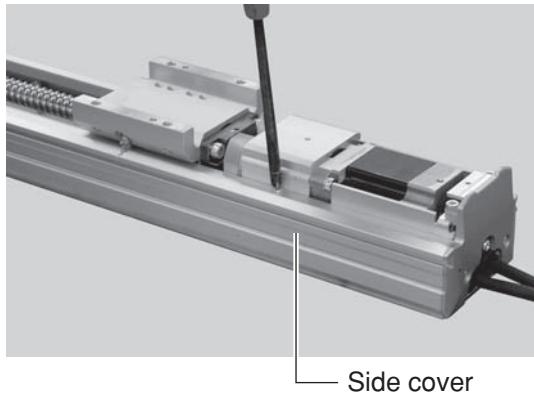


### CAUTION

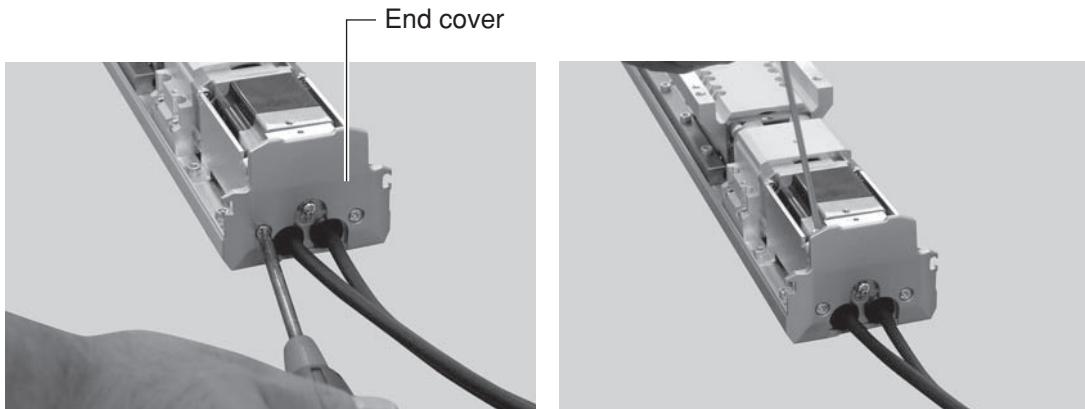
A positional shift occurs by replacing the motor. It is therefore necessary to perform return-to-origin and set point data again after replacing the motor.  
When removing the parts, note their positional relation and assembly order.

- 1) Turn off the controller power.
- 2) Remove the three screws securing the robot top cover and remove the top cover.  
(For how to remove the top cover, refer to "3-3 Installing the robot".)
- 3) Remove the two screws securing each side cover and remove the side covers.

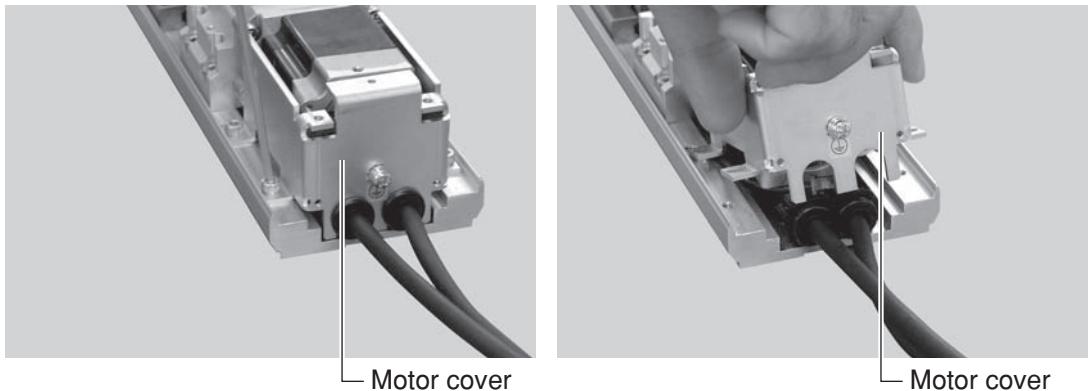
4



- 4) Remove the four screws securing the end cover on the motor side and remove the end cover.

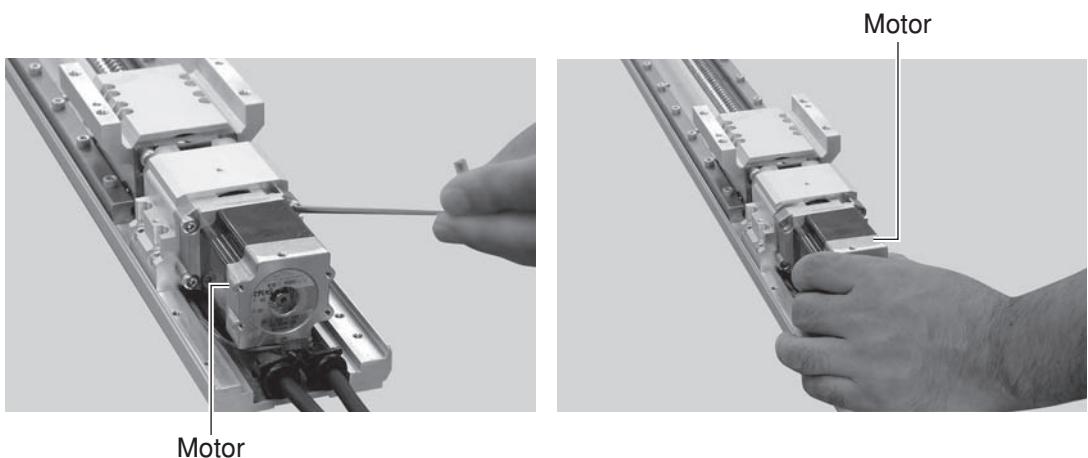


- 5) Remove the four screws securing the motor cover and remove the motor cover.



- 6) Remove the ground wire.

- 7) Remove the four bolts securing the motor and remove the motor.

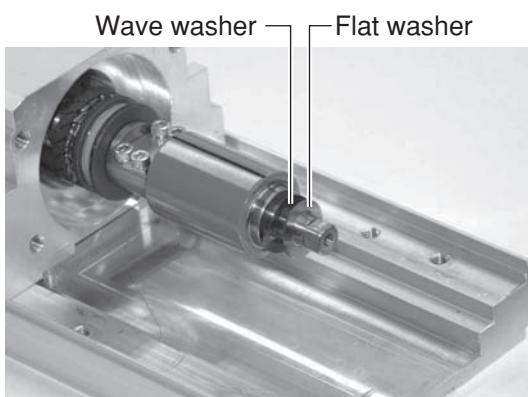


- 8) Remove the wave washer and flat washer.



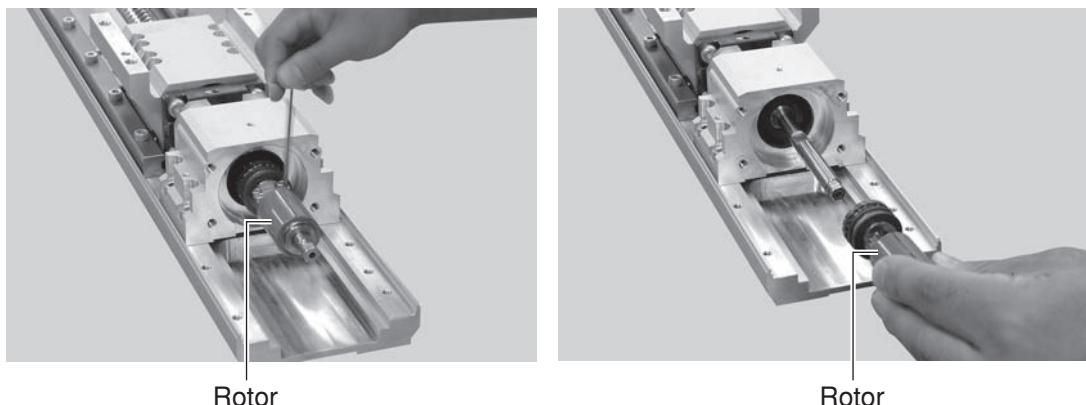
**CAUTION**

When removing the motor, the flat washer might be left in the bearing inside the motor, so use caution.



#### 4-4 Replacing the motor

- 9) Remove the four bolts securing the rotor and pull out the rotor.



- 10) Install the new rotor.

- 11) Install the wave washer and flat washer in the correct order.

- 12) Install the new motor.

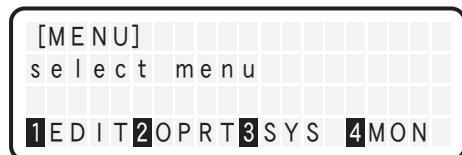
- 13) Reassemble in the reverse order (steps 11 to 2).

4

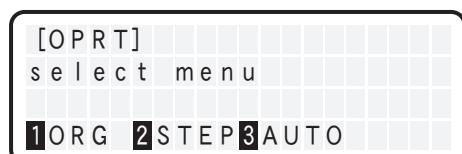
Periodic Inspection and Maintenance

### ● Checking the grid position (for SR1)

- 1) Press **F2** (OPRT) on the initial menu screen.

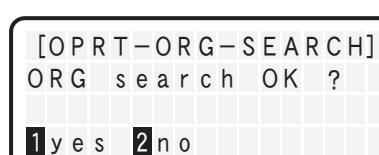


- 2) Press **F1** (ORG).



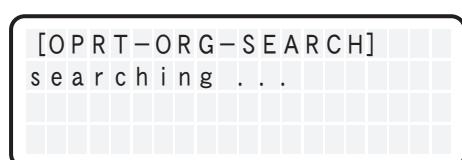
- 3) Press **F1** (yes) to perform return-to-origin.

To cancel the operation, press **F2** (no).



- 4) This screen appears during return-to-origin.

Pressing **STOP** during operation stops the robot and displays a message. Then pressing **ESC** returns to the screen of 2).



- 5) When return-to-origin ends normally, the machine reference value appears on the bottom right of the screen.



- 6) Press **B8** to display the grid position.

**MEMO**

## Contents

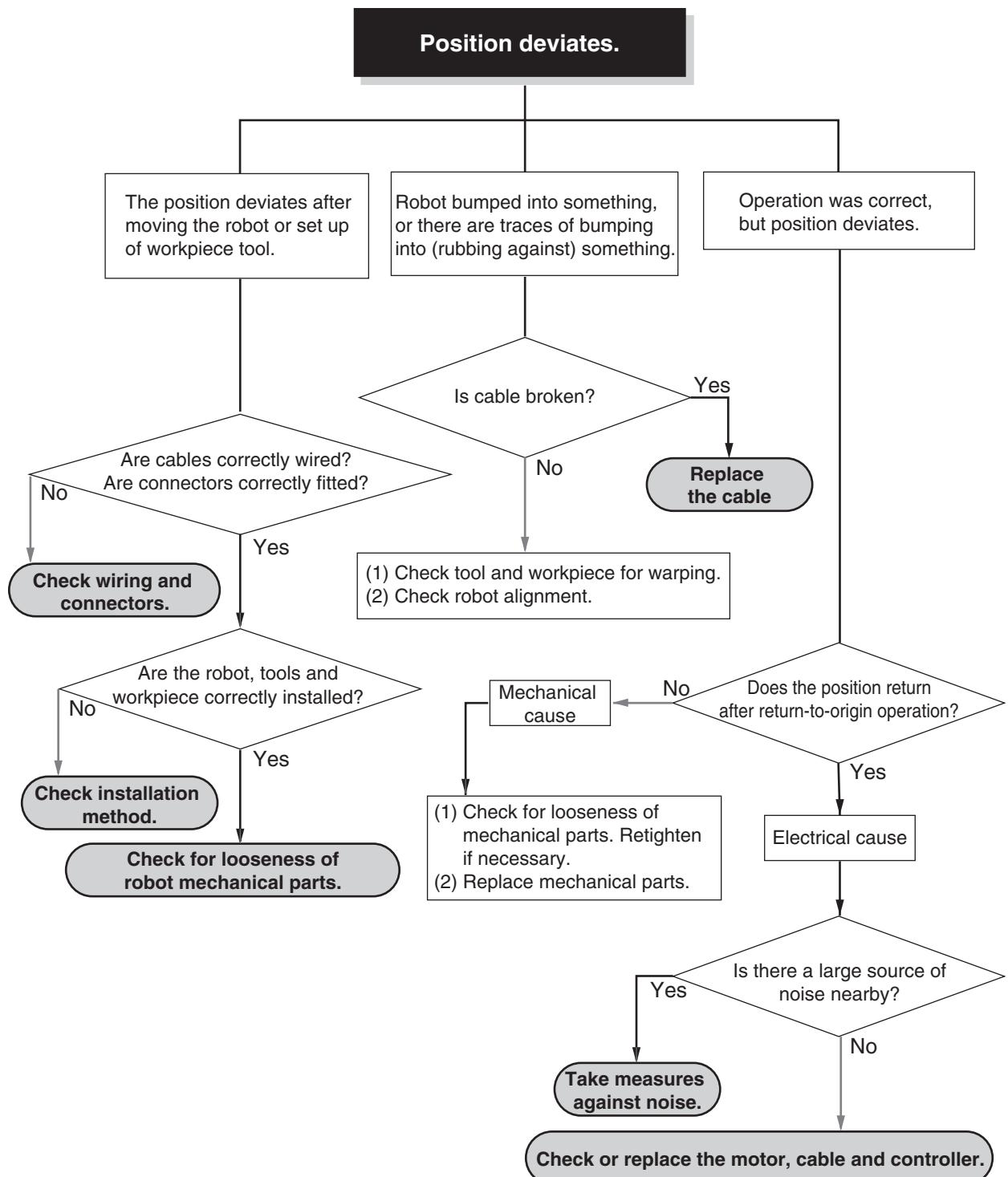
<b>5-1 If you suspect trouble</b>	<b>5-1</b>
5-1-1 Positioning error	5-1
5-1-2 Feedback error	5-2



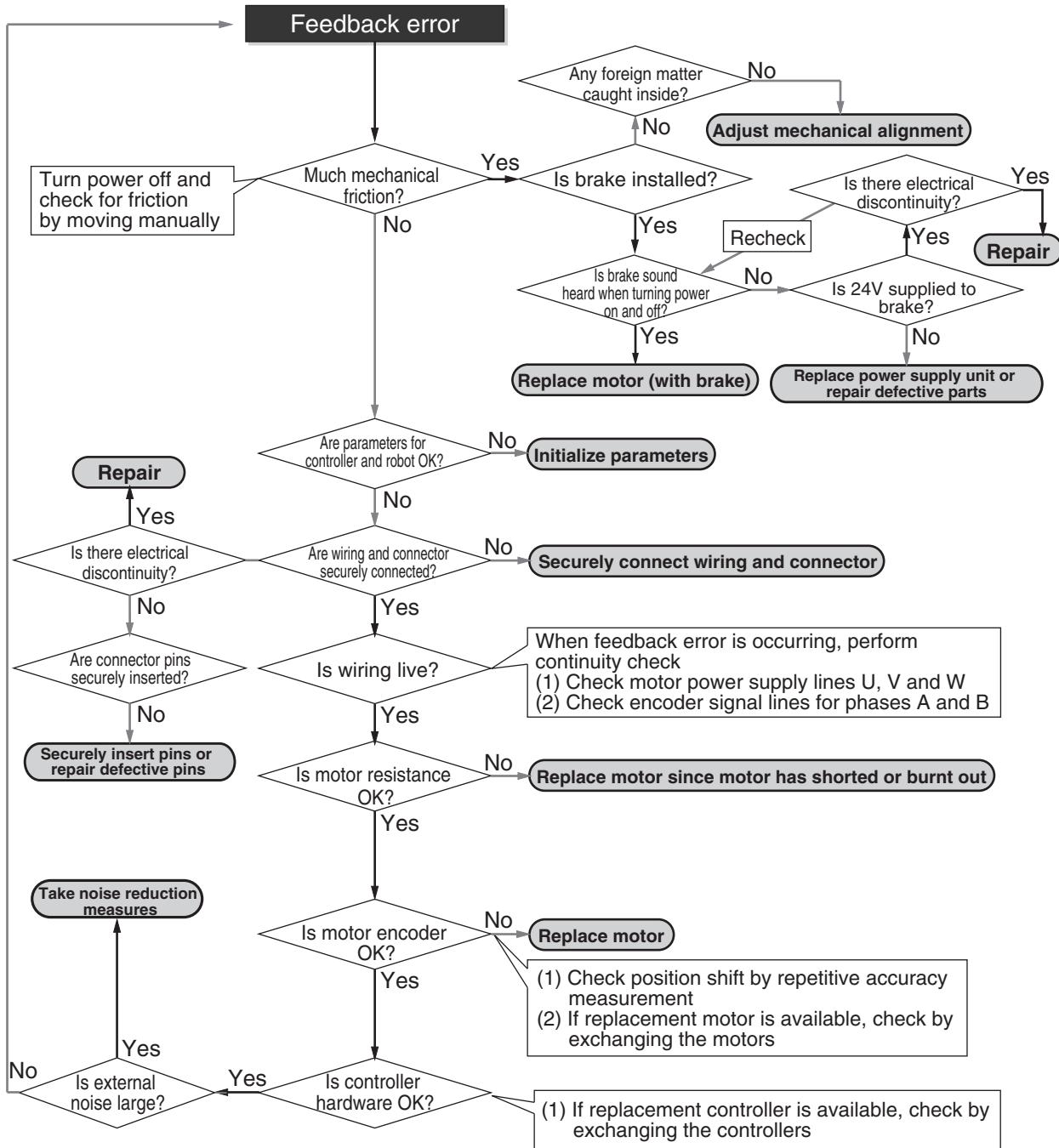
## 5-1 If you suspect trouble

If an error such as a positioning error or feedback error occurs, check the following points to find the solution before you determine the robot or controller has malfunctioned. If the trouble still exists even after checking these points, please contact us with a detailed description of the trouble.

### 5-1-1 Positioning error



## 5-1-2 Feedback error



## Contents

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# 6-1 Main unit specifications

## 6-1-1 F8

### ● Basic specifications

Motor output AC (W)		100		
Repeated positioning accuracy (mm) *1		±0.02		
Deceleration mechanism		Ball screw φ12 (Class C10)		
Ball screw lead (mm)		20	12	6
Maximum speed (mm/sec) *2		1200	720	360
Maximum payload (kg)	Horizontal installation	12	20	40
	Vertical installation	—	4	8
Rated thrust (N)		84	141	283
Stroke (mm)		150 to 800 (50 pitch)		
Total length (mm)	Horizontal installation	Stroke length + 286		
	Vertical installation	Stroke length + 316		
Maximum cross-section outside dimensions (mm)		W80×H65		
Cable length (m)		Standard : 3.5 Option: 5/10		
Controller	Horizontal installation	SR1-X, TS-X, RCX222, RCX240		
	Vertical installation	SR1-X, TS-X, RCX222, RCX240		
Robot driver	Horizontal installation	RDX-05-RBR1		
	Vertical installation	RDX-05-RBR1		

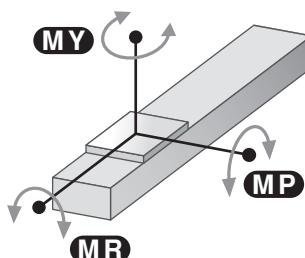
\*1: Positioning repeatability in one direction.

\*2: When the stroke is longer than 600mm, the ball screw may resonate depending on the moving range (critical speed). In this case, adjust to reduce the operating speed by referring to the maximum speeds shown in the table below.

Effective stroke	150	200	250	300	350	400	450	500	550	600	650	700	750	800
Maximum speed (mm/sec)	Lead 20	1200						1080	900	780	720	600		
	Lead 12	720						648	540	468	432	360		
	Lead 6	360						324	270	234	216	180		
	Speed setting	—						90%	75%	65%	60%	50%		

### ● Static loading moment

(Unit: N·m)		
MY	MP	MR
70	95	110

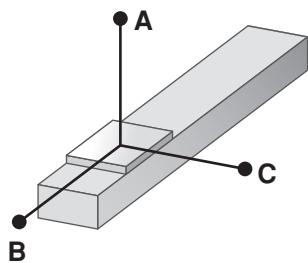


## 6-1 Main unit specifications

### ● Allowable overhang\*

\* Distance from the center on the top face of slider to the gravity center of the item being carried. (This is calculated assuming that the service life of the guide is 10,000km.)

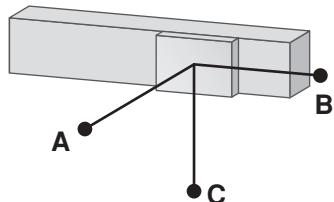
#### ■ Horizontal installation



**Horizontal installation (Unit: mm)**

		A	B	C
Lead 20	5kg	197	76	120
	10kg	100	32	54
	12kg	85	25	43
Lead 12	5kg	364	89	188
	10kg	203	39	87
	15kg	139	22	51
	20kg	103	14	33
Lead 6	10kg	403	43	113
	20kg	214	16	43
	30kg	140	6	20
	40kg	113	0	8

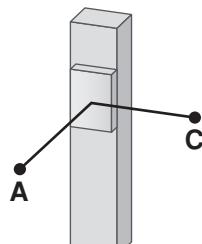
#### ■ Wall installation



**Wall installation (Unit: mm)**

		A	B	C
Lead 20	5kg	104	67	174
	10kg	37	23	72
	12kg	27	15	55
Lead 12	5kg	171	81	340
	10kg	69	32	172
	15kg	33	15	100
	20kg	15	6	55
Lead 6	10kg	94	36	369
	20kg	25	9	157
	30kg	0	0	14
	40kg	0	0	0

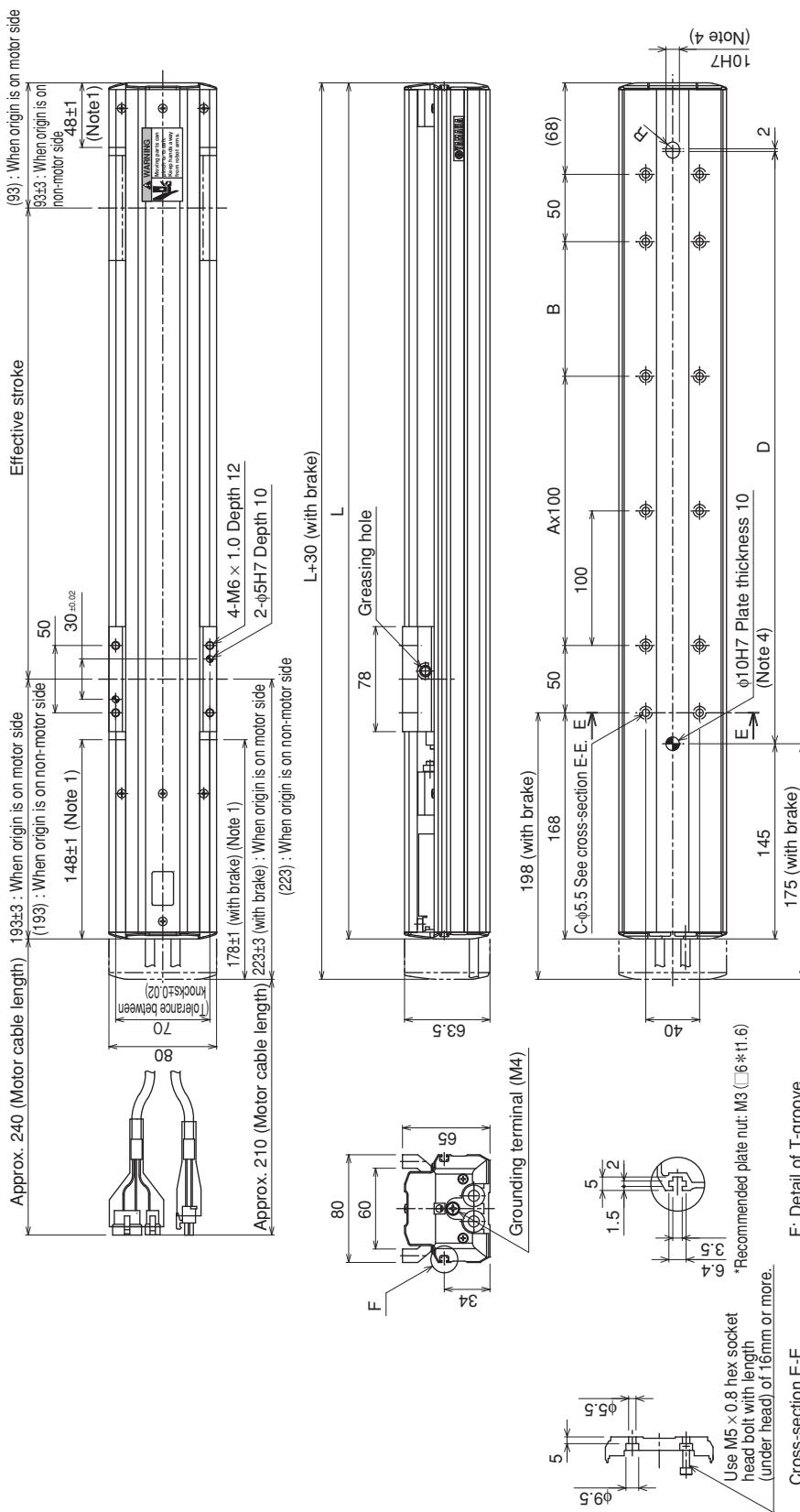
#### ■ Vertical installation



**Vertical installation (Unit: mm)**

		A	C
Lead 12	1kg	447	448
	2kg	214	216
	3kg	137	138
	4kg	98	99
Lead 6	2kg	244	245
	4kg	113	113
	6kg	69	69
	8kg	46	46

## F8 Dimensions



Note 1. Distance from both ends to the mechanical stopper.

Note 2. When installing the robot, do not use washers inside the robot body.

Note 3. Minimum bend radius of motor cable is R50 (50mm).

Note 4. When using this φ10 knock-pin hole to position the robot body, the knock-pin must not protrude more than 10mm inside the robot body.

Note 5. Weight excluding brake. Weight of brake-equipped robots is 0.3kg heavier than the weight of robots with no brake (shown in the table).

Effective stroke	150	200	250	300	350	400	450	500	550	600	650	700	750	800
L	436	486	536	586	636	686	736	786	836	886	936	986	1036	1086
A	0	0	1	1	2	2	3	3	4	4	5	5	6	6
B	100	150	100	150	100	150	100	150	100	150	100	150	100	150
C	8	8	10	10	12	12	14	14	16	16	18	18	20	20
D	240	290	340	390	440	490	540	590	640	690	740	790	840	890
Weight (kg) Note 5	3.6	3.9	4.2	4.4	4.7	5.0	5.3	5.6	5.9	6.2	6.4	6.7	7.0	7.3

## 6-1-2 F8L

### ● Basic specifications

Motor output AC (W)		100							
Repeated positioning accuracy (mm) *1		$\pm 0.01$							
Deceleration mechanism		Ball screw $\phi 15$ (Class C7)							
Ball screw lead (mm)		30	20	10	5				
Maximum speed (mm/sec) *2		1800	1200	600	300				
Maximum payload (kg)	Horizontal installation	7	20	40	50				
	Vertical installation	—	4	8	16				
Rated thrust (N)		56	84	169	339				
Stroke (mm)	150 to 1050 (50 pitch)								
Total length (mm)	Horizontal installation	Stroke length + 300	Stroke length + 292						
	Vertical installation	—	Stroke length + 322						
Maximum cross-section outside dimensions (mm)	W80×H65								
Cable length (m)	Standard : 3.5 Option: 5/10								
Controller	Horizontal installation	SR1-X, TS-X, RCX222, RCX240							
	Vertical installation	SR1-X, TS-X, RCX222, RCX240							
Robot driver	Horizontal installation	RDX-05-RBR1							
	Vertical installation	RDX-05-RBR1							

\*1: Positioning repeatability in one direction.

\*2: When the stroke is longer than 700mm, the ball screw may resonate depending on the moving range (critical speed). In this case, adjust to reduce the operating speed by referring to the maximum speeds shown in the table below.

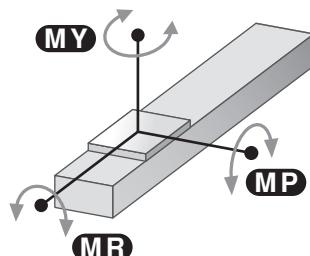
Effective stroke	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	1050
Maximum speed (mm/sec)	Lead 20	1200					1020	900	780	720	660	600	540	480					
	Lead 10	600					510	450	390	360	330	300	270	240					
	Lead 5	300					255	225	195	180	165	150	135	120					
	Speed setting	—					85%	75%	65%	60%	55%	50%	45%	40%					

### High lead type: Lead 30

Effective stroke	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	1050
Maximum speed (mm/sec)	Lead 30	1800					1530	1350	1170	1080	990	900	810	720					
	SPEED setting	—					85%	75%	65%	60%	55%	50%	45%	40%					

### ● Static loading moment

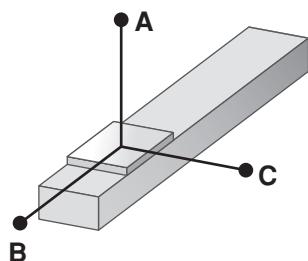
(Unit: N·m)		
MY	MP	MR
70	95	110



### ● Allowable overhang\*

\* Distance from the center on the top face of slider to the gravity center of the item being carried. (This is calculated assuming that the service life of the guide is 10,000km.)

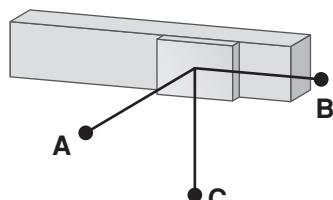
#### ■ Horizontal installation



**Horizontal installation (Unit: mm)**

		A	B	C
Lead 30	5kg	112	80	80
	7kg	78	43	49
Lead 20	5kg	211	108	147
	10kg	116	45	69
Lead 10	15kg	76	24	39
	20kg	58	14	26
Lead 5	10kg	251	56	122
	20kg	121	20	46
Lead 10	30kg	74	8	20
	40kg	35	0	6
Lead 5	20kg	249	23	62
	30kg	170	10	29
Lead 5	40kg	138	4	12
	50kg	51	0	0

#### ■ Wall installation

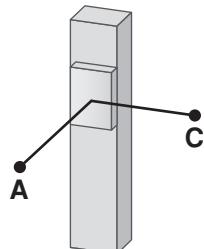


**Wall installation (Unit: mm)**

		A	B	C
Lead 30	5kg	55	57	77
	7kg	21	19	34
Lead 20	5kg	119	89	176
	10kg	38	26	69
Lead 10	15kg	7	0	16
	20kg	0	0	0
Lead 5	10kg	85	39	202
	20kg	7	0	30
Lead 5	30kg	0	0	0
	40kg	0	0	0
Lead 5	20kg	19	7	140
	30kg	0	0	0
Lead 5	40kg	0	0	0
	50kg	0	0	0

## 6-1 Main unit specifications

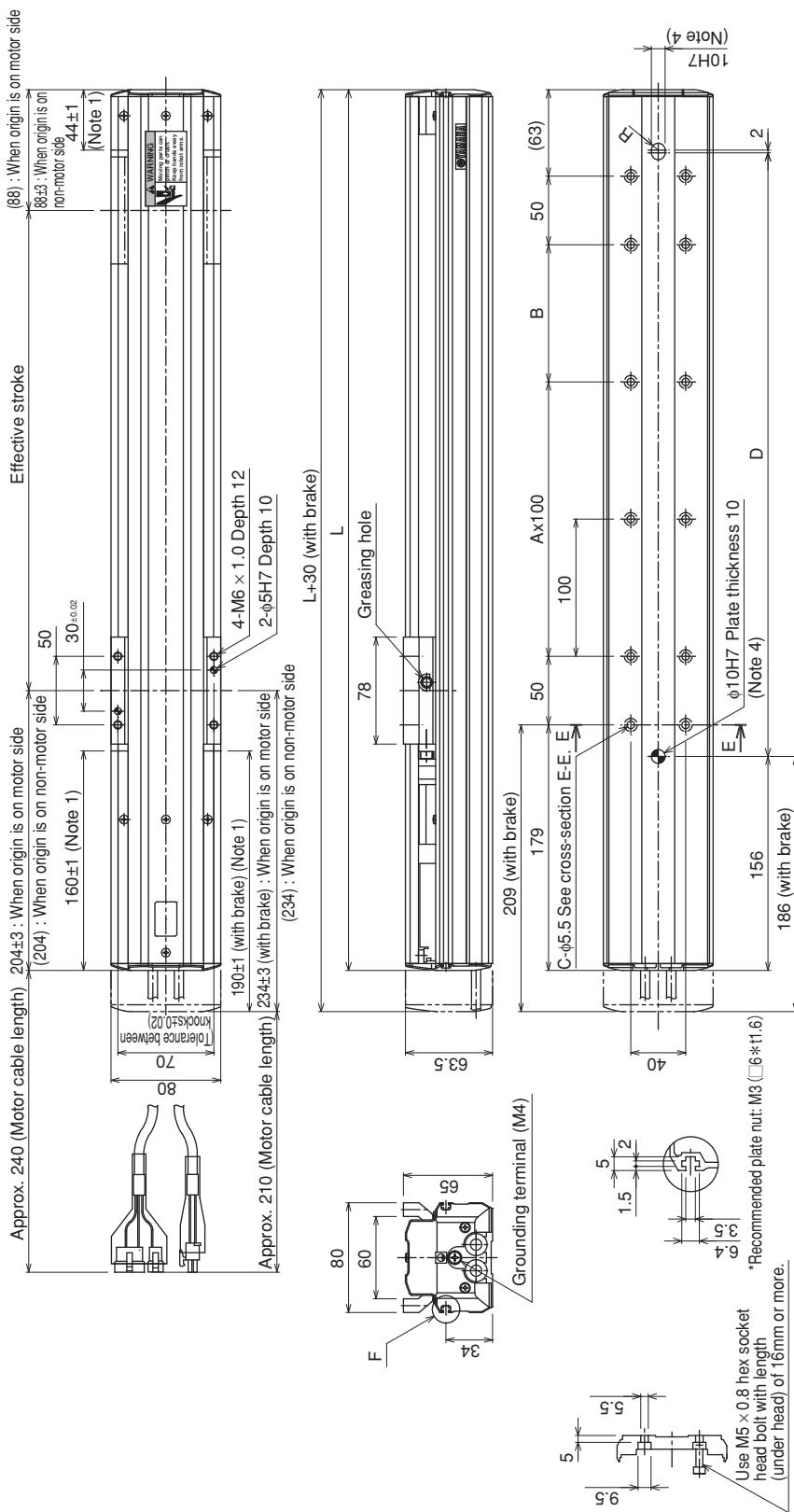
### ■ Vertical installation



Vertical installation (Unit: mm)

		A	C
Lead 20	2kg	236	240
	4kg	106	110
Lead 10	2kg	310	311
	4kg	141	143
	6kg	85	86
	8kg	57	58
	5kg	123	124
Lead 5	10kg	47	48
	15kg	22	22
	16kg	19	19

## F8L Dimensions



F: Detail of T-groove

Cross-section E-E

Note 1. Distance from both ends to the mechanical stopper.

Note 2. When installing the robot, do not use washers inside the robot body.

Note 3. Minimum bend radius of motor cable is R50 (50mm).

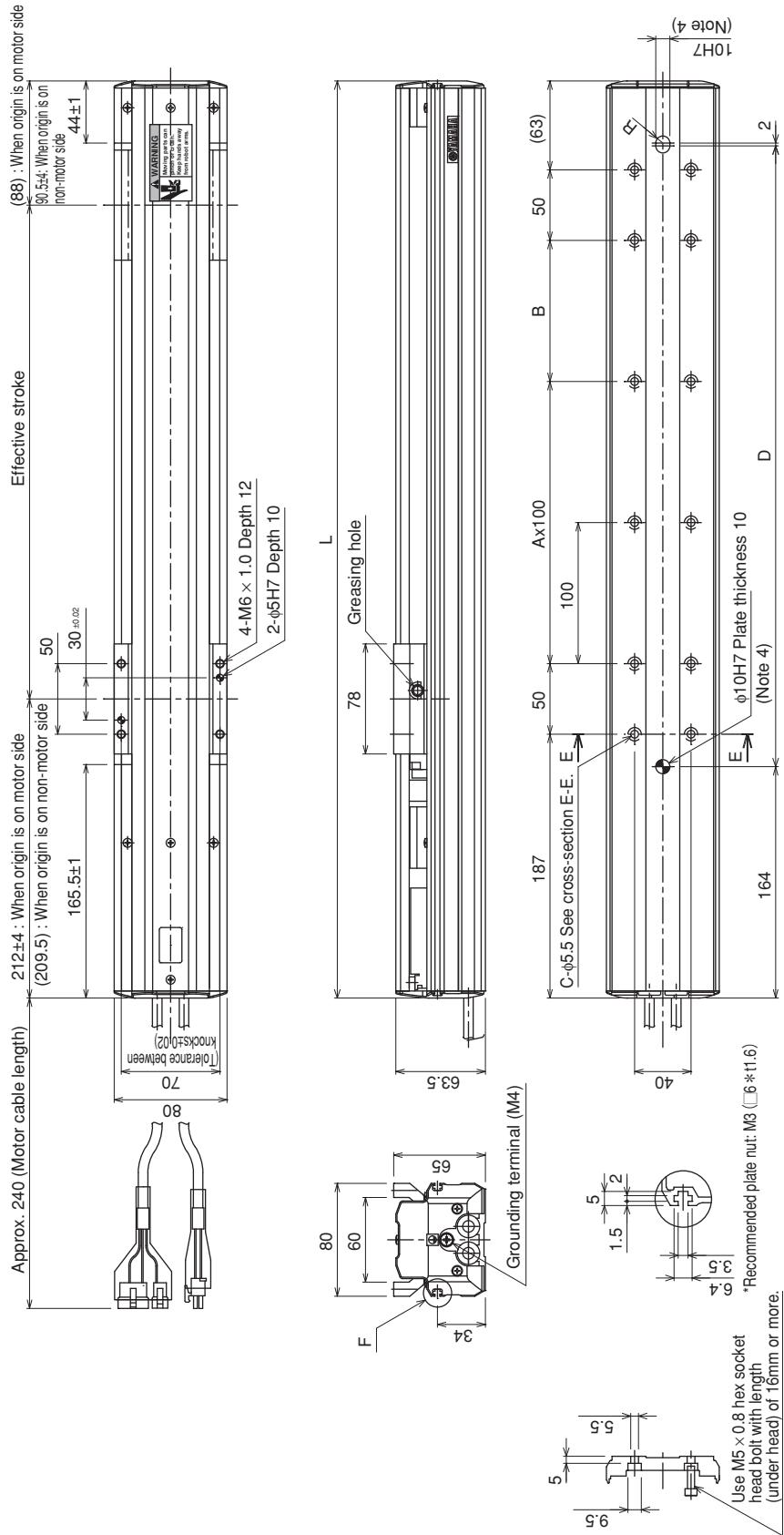
Note 4. When using this  $\phi 10$  knock-pin hole to position the robot body, the knock-pin must not protrude more than 10mm inside the robot body.

Note 5. Weight excluding brake. Weight of brake-equipped robots is 0.3kg heavier than the weight of robots with no brake (shown in the table).

Effective stroke	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	1050
L	442	492	542	592	642	692	742	792	842	892	942	992	1042	1092	1142	1192	1242	1292	1342
A	0	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9
B	100	150	100	100	150	100	150	100	150	100	150	100	150	100	150	100	150	100	100
C	8	8	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24	26
D	240	290	340	390	440	490	540	590	640	690	740	790	840	890	940	990	1040	1090	1140
Weight (kg) Note 5	3.9	4.2	4.5	4.8	5.1	5.4	5.7	6.1	6.4	6.7	7.0	7.3	7.6	7.9	8.2	8.5	8.8	9.2	9.5

## • F8L Dimensions (High lead type: Lead 30)

## 6-1 Main unit specifications



Note 1 Distance from both ends to the mechanical stopper

Note 4. When using this φ10 knock-pin hole to position the robot body, the knock-pin must not protrude more than 10mm inside the robot body.

## 6-1-3 F8LH

### ● Basic specifications

Motor output AC (W)		100		
Repeated positioning accuracy (mm) *1		$\pm 0.01$		
Deceleration mechanism		Ball screw φ15 (Class C7)		
Ball screw lead (mm)		20	10	5
Maximum speed (mm/sec) *2		1200	600	300
Maximum payload (kg)	Horizontal installation	30	60	80
Rated thrust (N)		84	169	339
Stroke (mm)		150 to 1050 (50 pitch)		
Total length (mm)		Stroke length + 368		
Maximum cross-section outside dimensions (mm)		W80×H65		
Cable length (m)		Standard : 3.5 Option: 5/10		
Controller	Horizontal installation	SR1-X, TS-X, RCX222, RCX240		
	Vertical installation	SR1-X, TS-X, RCX222, RCX240		
Robot driver	Horizontal installation	RDX-05-RBR1		
	Vertical installation	RDX-05-RBR1		

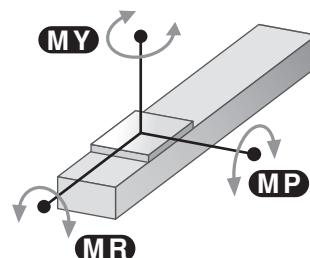
\*1: Positioning repeatability in one direction.

\*2: When the stroke is longer than 650mm, the ball screw may resonate depending on the moving range (critical speed). In this case, adjust to reduce the operating speed by referring to the maximum speeds shown in the table below.

Effective stroke	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	1050
Maximum speed (mm/sec)	Lead 20	1200					1020	900	780	720	660	600	540	480	420				
	Lead 10	600					510	450	390	360	330	300	270	240	210				
	Lead 5	300					255	225	195	180	165	150	135	120	105				
	Speed setting	-					85%	75%	65%	60%	55%	50%	45%	40%	35%				

### ● Static loading moment

(Unit: N·m)		
MY	MP	MR
128	163	143

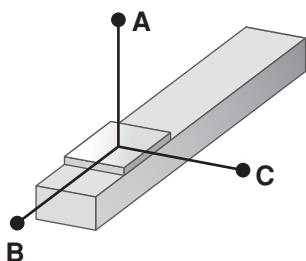


## 6-1 Main unit specifications

### ● Allowable overhang\*

\* Distance from the center on the top face of slider to the gravity center of the item being carried. (This is calculated assuming that the service life of the guide is 10,000km.)

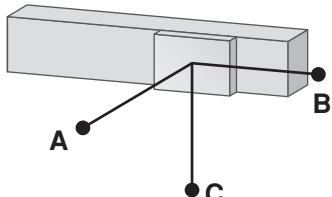
#### ■ Horizontal installation



Horizontal installation (Unit: mm)

		A	B	C
Lead 20	10kg	573	256	176
	20kg	334	116	81
	30kg	279	70	50
Lead 10	20kg	629	137	111
	40kg	479	57	47
	60kg	382	30	25
Lead 5	20kg	1094	148	127
	40kg	851	63	54
	60kg	714	34	29
	80kg	601	20	17

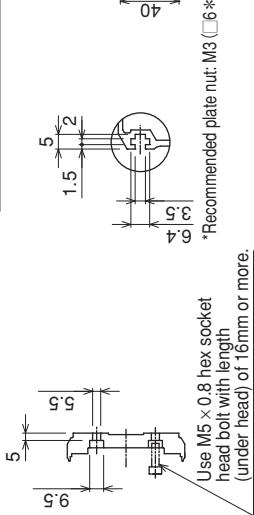
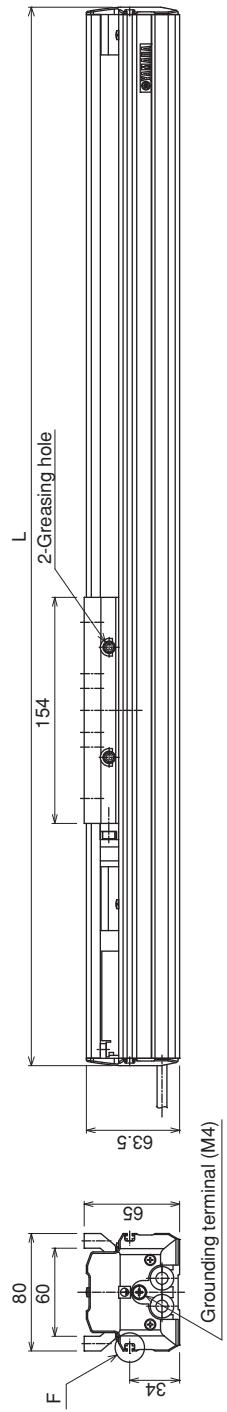
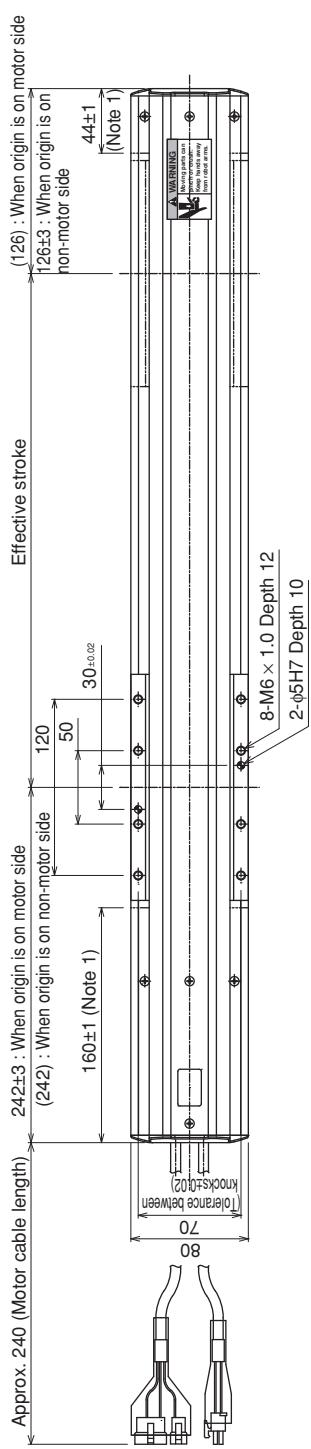
#### ■ Wall installation



Wall installation (Unit: mm)

		A	B	C
Lead 20	10kg	147	215	515
	20kg	53	75	255
	30kg	20	29	160
Lead 10	20kg	80	99	545
	40kg	15	19	270
	60kg	0	0	0
Lead 5	20kg	96	112	1005
	40kg	22	26	604
	60kg	0	0	0
	80kg	0	0	0

## ● F8LH Dimensions



F: Detail of T-groove

Note 1. Distance from both ends to the mechanical stopper.

Note 3. Minimum bend radius of motor cable is R50 (50mm).  
 Note 4. When using this φ10 knock-pin hole to position the robot body, the knock-pin must not protrude more than 10mm inside the robot body.

	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	1050
Effective stroke	L	518	568	618	668	718	768	818	868	918	968	1018	1068	1118	1168	1218	1268	1318	1368
A	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	
B	150	100	150	100	150	100	150	100	150	100	150	100	150	100	150	100	150	100	
C	8	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24	26	
D	290	340	390	440	490	540	590	640	690	740	790	840	890	940	990	1040	1090	1140	
Weight (kg)	4.7	5.0	5.3	5.6	5.9	6.2	6.6	6.9	7.2	7.5	7.8	8.1	8.4	8.7	9.0	9.3	9.7	10.0	

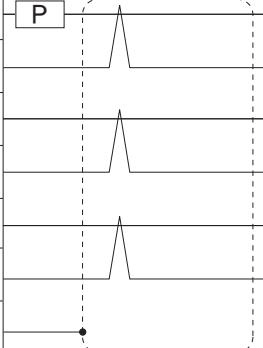
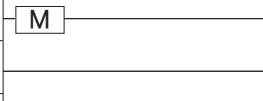
## 6-2 AC servo motor specifications

### 6-2-1 AC servo motor termination

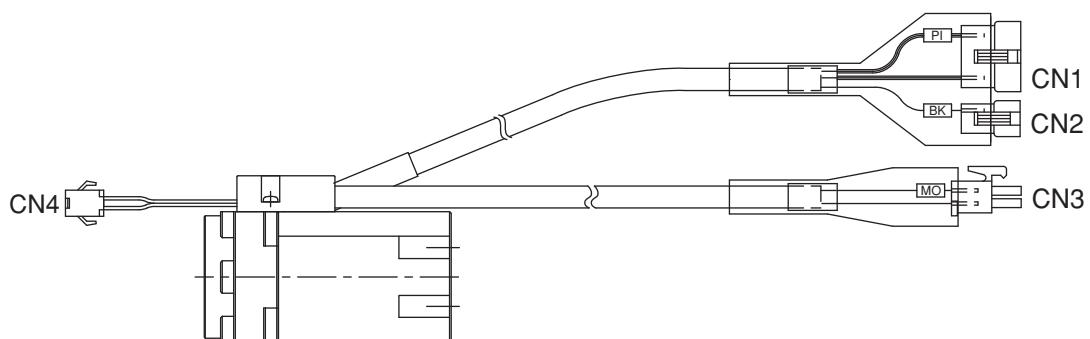
#### ■ Connector specifications

No.	Parts	Type No.	Maker	Qty	Notes
1	Servo motor			1	
2	Receptacle housing	SMR-07V-B	JST	1	CN1 (7 polarities)
3	Pin contact	BYM-001T-P0.6	JST	9	CN1, CN2
4	Plug housing	176273-1	AMP	1	CN3 (4 polarities)
5	Receptacle	175156-2	AMP	4	CN3
6	Receptacle housing	SMR-02V-B	JST	1	CN2 (2 polarities)
7	Plug housing	SMR-02V-BC	JST	1	CN4 (2 polarities)
8	Socket contact	BHF-001T-0.8BS	JST	2	CN4
9	Round terminal	1.25-M4		1	

#### ■ Connector wiring

Connector	Pin No.	Signal	Wire Color	Connection	
CN1	1	S2	Yellow		Motor
	2	S4	Blue		
	3	S1	Red		
	4	S3	Black		
	5	R1	White		
	6	R2	Green		
	7	Shield	Black *1		
CN2	1	BK	Brown		1
	2	BK	Gray		2
CN3	1	U	Red		Motor
	2	V	White		
	3	W	Black		
	4	CG	Yellow/Green		

\*1: Heat shrinkable tube



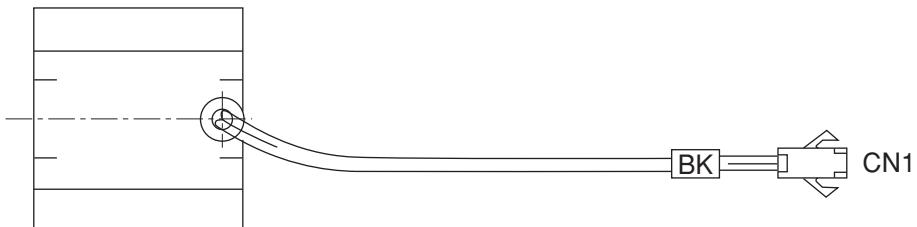
## 6-2-2 Brake cable specifications

### ■ Connector specifications

No.	Parts	Type No.	Maker	Qty	Note
1	Brake parts			1	
2	Receptacle housing	SMR-02V-B	JST	1	CN1
3	Pin contact	BYM-001T-P0.6	JST	9	CN1

### ■ Connector wiring

Connector	Pin No.	Signal	Wire Color
CN1	1	S1	Yellow (black)
	2	S2	Yellow (black)

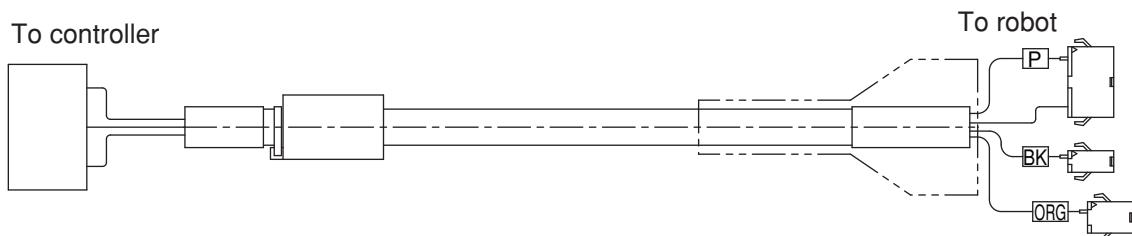


## 6-3 Robot cables

## 6-3 Robot cables

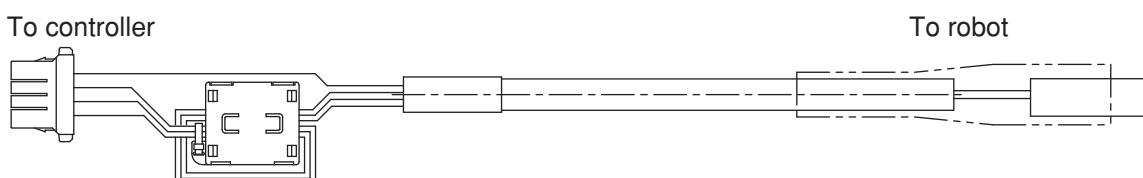
## 6-3-1 Robot cables (SR1)

## ■ Signal cable



Parts	Signal	PIN	Connection	PIN	Parts	Wire	
Controller CN1	S2	1		1	Resolver	0.3sq Blue	SPMCU-14K
	S4	2		2		Orange	
	S1	3		3		Green	
	S3	4		4		Brown	
	R1	5		5		Grey	
	R2	6		6		Red	
	D.G.	9		7		Clear	Shield
	BK+	17		1	Brake	Black	
	BK-	18		2		Yellow	
	ORG	12		2	ORG	Pink	
	24V	13		1		White	
	GND24	15		3		Blue/Red	

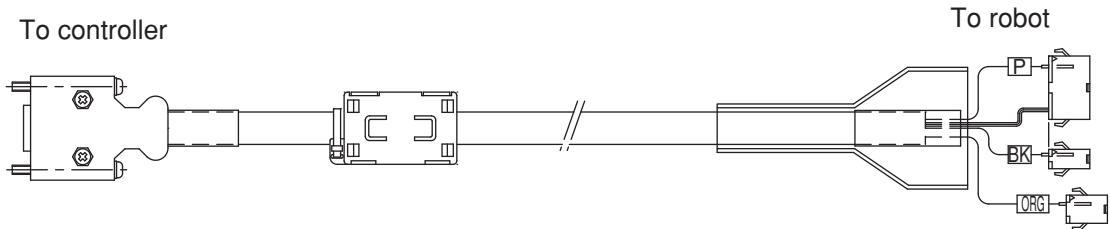
## ■ Power cable



Parts	Signal	PIN	Connection	PIN	Parts	Wire
Motor wire	FG	1		4		0.75sq Yellow/Green
	U	2		1		0.75sq Red
	V	4		2		0.75sq White
	W	3		3		0.75sq Black

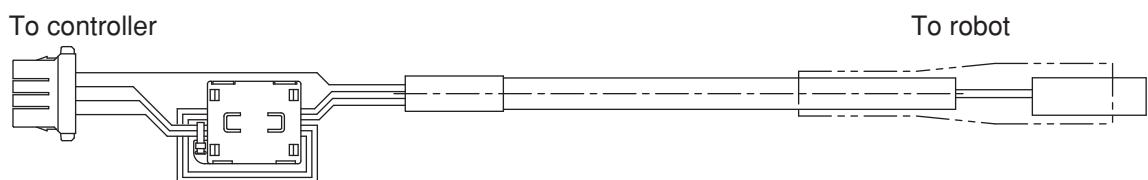
## 6-3-2 Robot cables (TS-X)

### ■ Signal cable



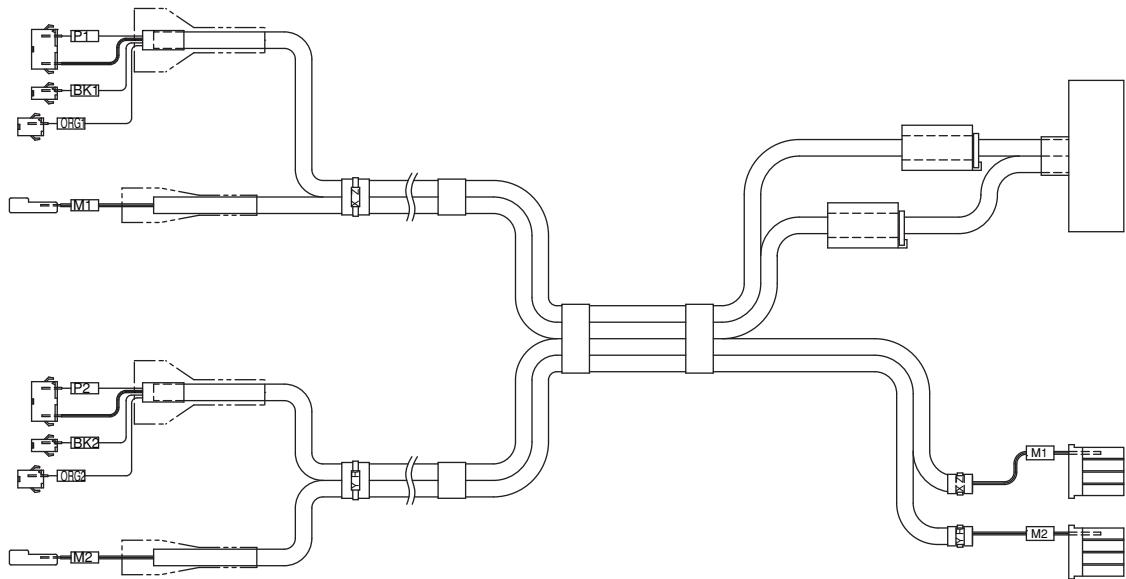
Parts	Signal	PIN	Connection	PIN	Parts	Wire	
Controller CN1	S2	1		1	Resolver	0.3sq Blue	SPMCU-14(K)
	S4	2		2		Orange	
	S1	3		3		Green	
	S3	4		4		Brown	
	R1	5		5		Grey	
	R2	6		6		Red	
	FG	7		7		Drain wire	
	BK+	13		1	Brake	Black	
	BK-	14		2		Yellow	
	ORG	12		2	ORG	Pink	
	24V	11		1		White	
	GND24	10		3		Blue/Red	

### ■ Power cable



Parts	Signal	PIN	Connection	PIN	Parts	Wire
Motor wire	FG	1		4		0.75sq Yellow/Green
	U	2		1		0.75sq Red
	V	4		2		0.75sq White
	W	3		3		0.75sq Black

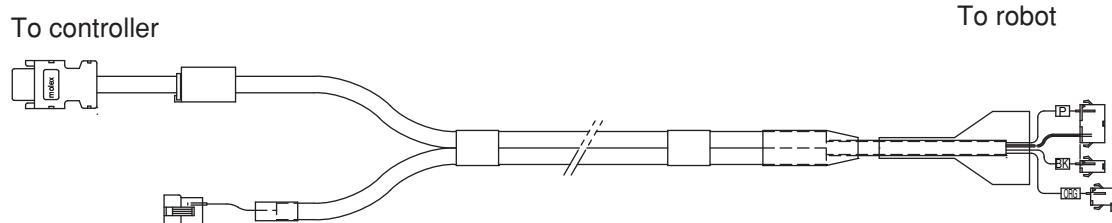
### 6-3-3 Robot cables (RCX222/240)



Signal	Connector	No.	Connection	No.	Connector	Wire	
Resolver S2	P1	1		1		0.3sq Twisted pair	Red
S4		2		2		Twisted pair	White
S1		3		3		0.3sq Twisted pair	Green
S3		4		4		Twisted pair	White
R1		5		5		0.3sq Twisted pair	Yellow
R2		6		6		Twisted pair	White
DG		7		7		Drain wire	
Brake MB+	BK1	1		14		0.3sq Twisted pair	Blue
MB-		2		16		Twisted pair	White
Sensor 24V	ORG1	1		9		0.3sq Twisted pair	Purple
ORG		2		12		0.3sq Twisted pair	Blue
GND24		3		13		Twisted pair	Brown
Resolver S2	P2	1		19		0.3sq Twisted pair	Red
S4		2		20		Twisted pair	White
S1		3		21		0.3sq Twisted pair	Green
S3		4		22		Twisted pair	White
R1		5		23		0.3sq Twisted pair	Yellow
R2		6		24		Twisted pair	White
DG		7		25		Drain wire	
Brake MB+	BK2	1		32		0.3sq Twisted pair	Blue
MB-		2		34		Twisted pair	White
Sensor 24V	ORG2	1		27		0.3sq Twisted pair	Purple
ORG		2		30		0.3sq Twisted pair	Blue
GND24		3		31		Twisted pair	Brown
HLIM				10			Green
GND24				11			
HLIM				28			Green
GND24				29			
U	M1	1		2	M1	0.75sq	Red
V		2		3		0.75sq	White
W		3		4		0.75sq	Black
FG		4		1		0.75sq	Yellow/Green
U	M2	1		2	M2	0.75sq	Red
V		2		3		0.75sq	White
W		3		4		0.75sq	Black
FG		4		1		0.75sq	Yellow/Green

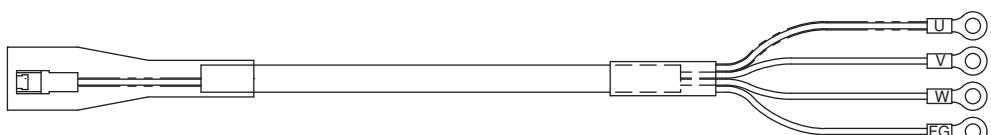
## 6-3-4 Robot cables (RDX)

### ■ Signal cable



Signal	Connector	No.	Connection	No.	Connector	Wire		
Encoder S2		5		1	P	0.3sq Twisted pair	Blue	
S4		6		2			Orange	
S1		7		3			Green	
S3		8		4			Brown	
R1		1		5			Grey	
R2		2		6			Red	
F.G.				7		Drain wire		
Brake BK+		1		1	BK	0.3sq Twisted pair	Blue	
BK-		2		2			Orange	
24V		3		1	ORG		Green	
ORG		4		2			Grey	
GND24		5		3			Red	

### ■ Power cable



Signal	Connector	No.	Connection	Connector	Wire Color
Motor wire U	M	1		Round terminal	Red
V		2			White
W		4			Black
FG		3			Yellow/Green



# Appendix

## Contents

About machine reference	i
Moment of inertia calculation	ii



## About machine reference

The position detector built into the motor issues a "0" pulse each time the motor rotates 1/4th of one turn. When return-to-origin is performed, a difference in distance occurs between the position where the origin signal is detected and the point at which the next "0" pulse is received. This is called the machine reference and is usually expressed as a percent, with 100% being equal to 1/4th of one turn of the motor. (See the figure below.)

The machine reference value must be within the allowable range (25 to 75%) to maintain axis movement repeatability.

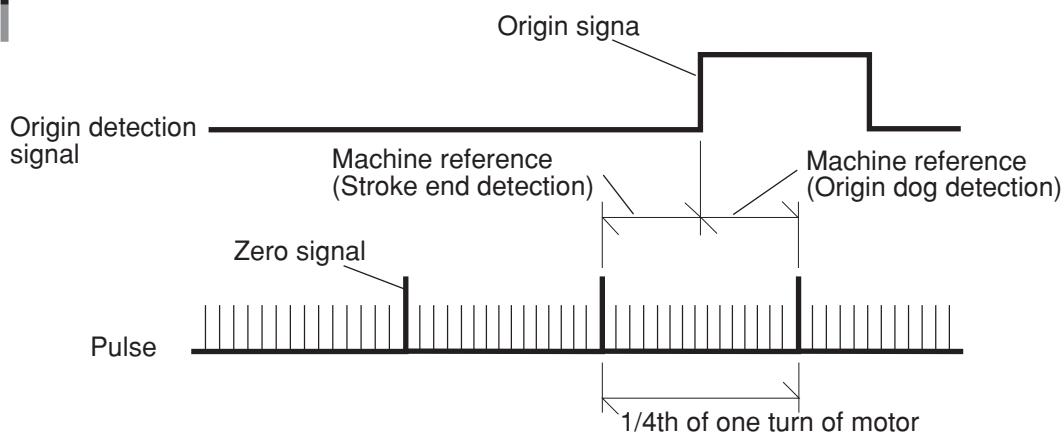
The optional programming box (HPB or RPB) or Handy Terminal (HT1) is needed to check the machine reference value. The machine reference value is displayed on the LCD screen of the programming box or Handy Terminal when return-to-origin is complete. (See the figure below.)



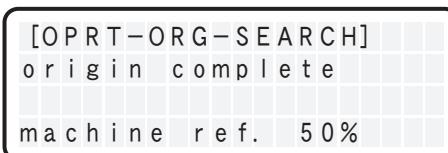
### NOTE

The F8/F8L/F8LH robots use an absolute type position detector. There is no need to perform return-to-origin each time the robot controller is turned on and readjust the machine reference value. If for some reason the machine reference adjustment becomes necessary, please contact YAMAHA sales office or dealer.

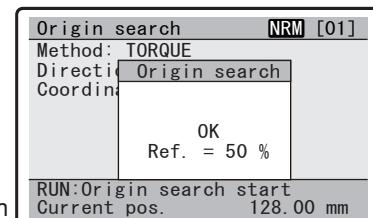
### Machine reference



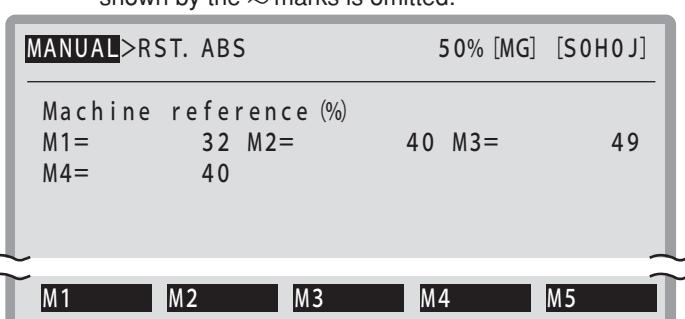
### Machine reference value display examples



SR1 \* In the screen illustration below, a section of the screen shown by the ≈ marks is omitted.



TS-X



RCX Series (Multiple FLIP-X control)

# Moment of inertia calculation



## CAUTION

The robot must be operated with correct tolerable moment of inertia and acceleration coefficients according to the manipulator tip mass and moment of inertia. If this is not observed, premature end to the life of the drive units, damage to the robot parts or residual vibration during positioning may result.

Usually the R axis load is not a simple form, and the calculation of the moment of inertia is not easy.

As a method, the load is replaced with several factors that resemble a simple form for which the moment of inertia can be calculated. The total of the moment of inertia for these factors is then obtained.

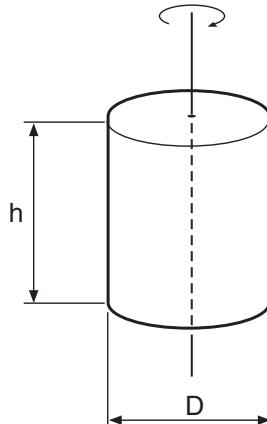
The objects and equations often used for the calculation of the moment of inertia are shown below.

## 1. Moment of inertia for cylinder

The moment of inertia ( $J$ ) for a cylinder having a rotation center such as shown below is given by

$$\begin{aligned} J &= \frac{\rho\pi D^4 h}{32g} = \frac{WD^2}{8g} \quad (\text{kgf}\cdot\text{cm}\cdot\text{sec}^2) \\ &= \frac{mD^2}{8} \quad (\text{kgm}^2) \end{aligned}$$

$\rho$  : Density ( $\text{kg}/\text{cm}^3$ )  
 $g$  : Gravitational acceleration ( $\text{cm}/\text{sec}^2$ )  
 $W$  : Weight of cylinder (kgf)  
 $m$  : Mass of cylinder (kg)

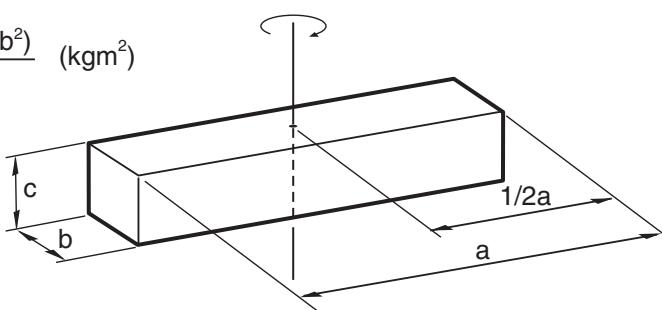


## 2. Moment of inertia for rectangular parallelepiped

The moment of inertia ( $J$ ) for a rectangular parallelopiped having a rotation center as shown below is given by

$$\begin{aligned} J &= \frac{\rho abc(a^2 + b^2)}{12g} = \frac{W(a^2 + b^2)}{12g} \quad (\text{kgf}\cdot\text{cm}\cdot\text{sec}^2) \\ &= \frac{m(a^2 + b^2)}{12} \quad (\text{kgm}^2) \end{aligned}$$

$\rho$  : Density ( $\text{kg}/\text{cm}^3$ )  
 $g$  : Gravitational acceleration ( $\text{cm}/\text{sec}^2$ )  
 $W$  : Weight of prism (kgf)  
 $m$  : Mass of prism (kg)

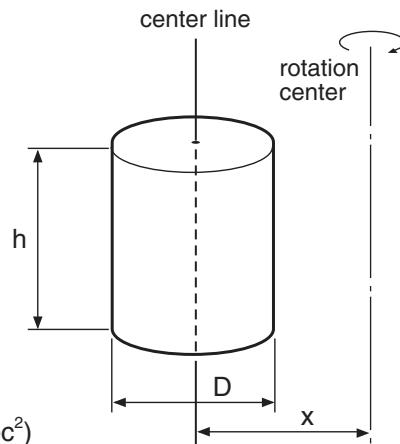


### 3. When the object's center line is offset from the rotation center.

The moment of inertia ( $J$ ) when the center of the cylinder is offset by a distance "x" from the rotation center as shown below is given by

$$\begin{aligned} J &= \frac{\rho\pi D^4 h}{32g} + \frac{\rho\pi D^2 h x^2}{4g} \\ &= \frac{WD^2}{8g} + \frac{Wx^2}{g} \text{ (kgf}\cdot\text{cm}\cdot\text{sec}^2) \\ &= \frac{mD^2}{8} + mx^2 \text{ (kgm}^2\text{)} \end{aligned}$$

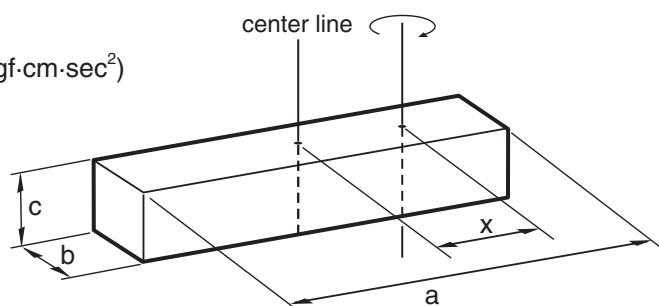
$W$  : Weight of cylinder (kgf)  
 $m$  : Mass of cylinder (kg)  
 $\rho$  : Density (kg/cm<sup>3</sup>)  
 $g$  : Gravitational acceleration (cm/sec<sup>2</sup>)



In the same manner, the moment of inertia ( $J$ ) of a prism as shown below is given by

$$\begin{aligned} J &= \frac{\rho abc(a^2 + b^2)}{12g} + \frac{\rho abcx^2}{g} \\ &= \frac{W(a^2 + b^2)}{12g} + \frac{Wx^2}{g} \text{ (kgf}\cdot\text{cm}\cdot\text{sec}^2) \\ &= \frac{m(a^2 + b^2)}{12} + mx^2 \text{ (kgm}^2\text{)} \end{aligned}$$

$W$  : Weight of prism (kgf)  
 $m$  : Mass of prism (kg)



## Revision record

Manual version	Issue date	Description
Ver. 2.01	Jun. 2009	Clerical error corrections.
Ver. 2.02	Dec. 2009	Some explanations were corrected or added in "Chapter 1 Using the Robot Safely".
Ver. 2.03	Aug. 2010	Clerical error corrections, etc.

## User's Manual

**YAMAHA** FLIP-X series  
Single-axis Robot **F8/F8L/F8LH**

Aug. 2010

Ver. 2.03

This manual is based on Ver. 2.03 of Japanese manual.

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IM Operations

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